A prospective comparative study of

FUNCTIONAL OUTCOME IN PATIENTS TREATED WITH INTERLOCKING NAILING AND DYNAMIC COMPRESSION PLATING FOR FRACTURE SHAFT OF HUMERUS IN ADULTS

Dissertation submitted to

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Award of the degree of

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CERTIFICATE

This is certify that **DR.P.VINODH RAJKUMAR**, Postgraduate student (2012-2013) in the Department of Orthopaedic surgery, Government Stanley Medical college has done dissertation on-

A PROSPECTIVE COMPARITIVE STUDY OF FUNCTIONAL OUTCOME IN PATIENTS TREATED WITH INTERLOCKING NAILING AND DYNAMIC COMPRESSION PLATING FOR FRACTURE SHAFT OF HUMERUS IN ADULTS

Under my guidance and supervision in partial fulfillment of the regulations laid down by THE TAMIL NADU DR.M.G.R.MEDIAL UNIVERSITY, CHENNAI-32 for the MS (Orthopedic Surgery) degree examination to be held in April 2014

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DECLARATION

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A PROSPECTIVE COMPARITIVE STUDY OF FUNCTIONAL OUTCOME IN PATIENTS TREATED WITHINTERLOCKING NAILING AND DYNAMIC COMPRESSION PLATING FOR FRACTURE SHAFT OF HUMERUS IN ADULTS

Is a bonafide work done by me at Government Stanley Medical College, Chennai between 2012-2014 under the guidence and supervision of our respected Head of The Department

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Place:Chennai DR.P.VINODH RAJKUMAR

Date:


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Match Overview
A PROSPECTIVE COMPARITIVE STUDY OF
FUNCTIONAL OUTCOME IN PATIENTS
TREATED WITH INTERLOCKING NAILING
AND DYNAMIC COMPRESSION PLATING
FOR FRACTURE SHAFT OF HUMERUS IN
ADULTS
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ABSTRACT

TITLE:

A Prospective Comparitive Study of Functional outcome in patients treated with Interlocking nailing and Dynamic compression plating for Fracture shaft of Humerus in adults

AIM OF THE STUDY

The aim of this study is to compare the Functional outcome in patients with fracture shaft of the humerus treated with Dynamic Compression plating and those treated with Intramedullary Interlocking nailing.

MATERIALS AND METHODS

This is a prospective comparative study of 24 patients with humeral shaft fractures treated with Intramedullary interlocking nailing and Plate osteosynthesis done in the Department of Orthopaedics, Government Stanley Medical College from june 2012 to september 2013.

CONCLUSION

The complications were more in our study in the interlocking nail group with most of them pertaining to poor shoulder function with pain. Though both modalities of treatment provide comparable union rates, secondary complications were more in interlocking nailing group. So I conclude that patients can be treated with dynamc compression plating and interlocking nailing for fracture of shaft of humerus. Intramedullary interlocking nailing is an effective and safe alternative for treatment of diaphyseal fractues of humerus. It is suitable for patients with osteoporosis, polytrauma and in segmental fractures.

INTRODUCTION

Fractures of the humeral shaft accounts for 1 to 3% of all fractures and it is one of the common fractures. They are caused by high energy trauma and most commonly seen in Middle third of the shaft.

Traditionally humeral shaft fractures have been treated non-operatively with hanging cast or brace. Sarmento et al reported use of plastic sleeve with early introduction of functional activity. But the non-operative treatment has disadvantages of prolonged immobilization in cast or brace which sometimes may be required as long as 6 months resulting in huge morbidity. Moreover, not all fractures of humeral shaft can be treated conservatively.

The various forms of conservative treatment available are

1.Coaptation splint:

It is indicated for acute humeral shaft fractures with minimal shortening and for short oblique or transverse fracture patterns. The disadvantages are irritation of theaxilla of patients and splint slippage.

2. Velpaeau bandage:

It is indicated for minimally displaced or undisplaced fractures that do not require reduction

3. Hanging arm cast:

Indicated for displaced midshaft humeral fractures with shortening, particularly spiral or oblique patterns. The patient must remain upright or semiupright at all times with the cast in a dependent position for effectiveness.

4. Functional bracing:

This uses hydrostatic soft tissue compression to effect and maintain fracture alignment while allowing motion of adjacent joints. It is usually applied for 1 or 2 weeks after the fracture is treated with hanging arm cast or coaptation splint.

Surgical options available are

1. Plate osteosynthesis
2. Intramedullary nailing
3. External fixation

Plate osteosynthesis is considered as gold standard of fixation of humeral shaft fractures comparing with other methods of fixation. But this requires extensive soft tissue dissection and complicated by the proximity of the radial nerve and the risk of mechanical failure in osteoporotic bones in old age.

Intramedullary interlocking nail is a better implant biomechanically. Nails are subjected to smaller bending loads and are less likely to fail due to fatigue. They act as load sharing and stress shielding devices. In cases of intramedullary nails,Cortical osteopenia that occurs right adjacent to the ends of plates is rarely seen. Thus chances of re-fracture after implant removal is less often seen. This does not require extensive soft tissue dissection but has stable fixation and rotational control. It can be done by antegrade or retrograde manner.

Traditionally the indication for closed intramedullary nailing of fracture of shaft of humerus are in polytrauma, in fractures with overlying burns, patients with osteoporotic bone, pathological fractures and in segmental fractures. The development of interlocking nail system has dramatically broadened the indication. Now shaft of humerus fracture with severe communition or bone loss, can now be treated with interlocking nails that control length and rotational alignment.

External fixation is used only as a method of treatment in compound injuries and not used as a method of definitive fixation.

So, a study was undertaken to evaluate the end results of twenty four cases to compare the functional outcomes of each method of fixation (dynamic compression plating and interlocking nailing) for the fracture shaft of humerus and to analyse the difference in the results of these two methods.

AIM OF THE STUDY

The aim of this study is to compare the Functional outcome in patients with fracture shaft of the humerus treated with Dynamic Compression plating and those treated with Intramedullary Interlocking nailing.

REVIEW OF LITERATURE

Methods of immobilisation of humerus fixation remains unchanged over several years. In the Edwin Smith Papyrus, circa 1600 BC, Egyptians first described treatment of 3 humeral shaft fractures with splints made of cloth, alum, and honey.

Thirteen hundred years after that, Greeks, in De Fracturis (400 BC), described traction using weight for closed reduction and mentioned about methods of splinting with bandages soaked in cerate which is an ointment composed of lard mixed with wax after reduction.

There are various splinting methods came into vogue, including hanging-arm cast, Thomas arm splints, modified Velpeau dressings, Coaptation splints, shoulder spica casts and abduction-type splints. Despite various methods mentioned the basic principle of stabilisation remains unchanged.

It was Sarmiento et all first described functional bracing, that a major advancement was made and the modern era of splinting was introduced.Since then functional bracing has become the gold standard for definitive management of the majority of midshaft humeral fractures.

It was Dr. J.A. Caldwell in 1933 who described hanging cast for fracture of the humerus. [1,2]. The hanging cast consist of a circular plaster bandage which encases the upper extremity from its upper third to the wrist; it hold the elbow in 90^0 flexion and suspended from its neck by a sling.

In 1982, George w. Balfour et al suggested diaphyseal fractures of humerus can be treated adequately by a ready –made fracture brace.[4]

Co-optation splints were used to keep the humerus fracture in secure and it was based on dependency method.

The functional brace management deviced by Sarmiento et al 1977 of humeral shaft fractures was reported to give high rate of union with good functional results.

Operative intervention was suggested for fracture humerus by Klernermanet et al and Belflour et al[4] and found that valus alignment of more than 15^0 was unacceptable cosmetically eventhough it was not found to have any functional impairment.

M J Bell et all found that excellent results can be achieved by plating fractures of the shaft of humerus in patients with multiple injuries.[5]

Bleeker et al in a retrospective study of 237 cases found that the incidence of delayed union was low after operative stabilisation.[6]

Blum j and Rommens et al found that the unreamed humeral nail a better implant for these fractures and found that it had the advantage to plate osteosyntheis in that nil is a biological type of stabilisation with minimal invasion of soft tissues with minimal damage perioteal and endosteal damage to blood supply.[7]

It was in 1961, Muller deviced a plate which was compressible by a plate using external compression device. This self compressing plate was semitubular plate with oval holes.[9]

In 1961, the Dynamic compression plate- DCP was reported for rigid internal fixation by Allogower and Perren[10,11.]. It was designed with

screw holes at the margin of the side of the plate hole to increased compression. It was possible to angulate the screw in hole to produced interfragmentary screw through the plate.

In a multicentric study conducted by Foster and Colleagues[12] from 1976 to 1983 they found that in 96 patients treated by AO plating methods and there was 100% union with good functional outcome in 27 cases.

Rush brothers[13] advocated intramedullary nailing of the humerus; elastic nails were used in Proximal diaphyseal fractures. It was based on principle that it allows for three point fixation in the intramedullary canal.

Ender[14] introduced flexible intramedullary nailing in 1978 for long bone fractures.

Leutennegar and Colleagues[15] operated in 18 patients with humeral shaft fractures with open reduction and internal fixation using AO plating method. Broad DCP was used for fixation of these fractures. They found bone healing in 17 patients with good functional outcome.

In 1986, Brumback RJ[16] et al found that Intramedullary nailing of humeral shaft was found to give excellent results with minimal loss of blood and risk of neurovascular structures while providing stability for mobilisation.

Apracioglu et al found that interlocking intramedullary nailing provides adequate fixation and early mobilisation.[17]

Siebert and Colleagues[18] studied the results of humeral shaft fractures treated by plating in 62 patients and found that the average time taken for bony union was around 16 Weeks.

Heim and Colleagues[19] treated 127 patients of humeral shaft fractures by open reduction and internal fixation with dynamic compression plating and found that out of 102 patients who came for followup, 89 had excellent or good functional results. And another 13patients had limitation of motion of shoulder or elbow or both. They concluded that correct plate fixation of humeral shaft fractures was good alternative to conservative treatment.

He and Colleagues[20] treated 47 humeral shaft fractures by open reduction and internal fixation with DCP using AO principles and found that out of 35 patients over a period of 3.5 years of followup the average time for bony union was 5.3 months. 36 patients had full range of motion of shoulder and elbows. And 89% were satisfied or very satisfied with the surgical outcome.

Osman and Colleagues[21] in France conducted a study of 156 humeral shaft fractures in adults treated by plate fixation. They found union rate in 94.2% and good or very good unions.

Parren[22] in 1989 introduced the limited contact dynamic compression plate (LC-DCP) and described the following aims of this new concept[23]. He found that there was minimal surgical damage to the blood supply, maintenance of optimal bone structure near the implant. There was improved healing in the critical zone in contact with the plate and minimal damage to the bone lining at plate removal with reduced risk of refracture.

Caldwell[24] studied variable factors of bone plate design like Screw torque, object radius of curvature, mode of bone plate application (compression or neutral loading) also influence the interface contact area and average force between a plate and object to which it is applied.

Mckee and Colleagues[25] in Boston used LC-DCP plates to treat upper limb fractures in 114 patients and found that of 108 cases with follow up there was fracture union in 111 cases without any further problems.

Haberneck[26] in 1991 used Siedels locking nail system and found overall good results with no case of pseudoarthosis, infection or radial nerve palsy. All patients regained full shoulder movements with no evidence of rotator cuff lesions.

Rodriguez[27] in 1991 prospectively studied a comparison between Hackethal nails and compression plates and found that functional results was better with compassion plates though union occurred in both groups.

Rommens and Colleagues[28] found retrograde locking nailing of humeral shaft fractures and found it to be better solution for the stabilization of fractures of humerus than antegrade nailing or plate and screw fixation.

Chhina[29] found in Amristar, using titanium LC-DCP that the radiological time of union was >16 weeks in 96% of patients and the functional outcome was excellent in 96% of cases.

Meekers and Broos[30] studied 161 fractures of humerus with 80 cases using plates and screws with DCP AND LC-DCP and 81 cases using interlocking nailing. The union rate was 92% in in plate group and union rate was less and complications were more in nailing group. So they recommended that plate and screw are superior to interlocking nailing in treatment of humeral fractures except in pathological fractures, very obese and in open fractures.

Hems[31] used interlocking nails for humeral shaft fractures and also in pathological fractures and found that they should be used with caution in management of non-pathological fractures.

In a study conducted by Crates and Whittle[32] using ante grade interlocking nailing of humeral fractures using 73 cases with Russel-Taylor humeral nailing they found 94% of fractures united primarily.

And 90% cases had full shoulder function and only in 1.4% cases had impingement from a prominent nail. They concluded that Russel Taylor nailing as an treatment of acute humeral shaft in multiply injured patients.

Lin[33] concluded from a comparative study of treatment of humeral shaft fractures using interlocking nailing and plate fixation that interlocking nail offered a less invasive surgical technique and good results than plate fixation.

Habernek and Orthner[34] found that Seidel interlocking nail caused shoulder pain in many patients after many years and withdrew their support for it.

Kropl and Colleagues[35] conducted in 2000 a study of 111 fractures with ante grade interlocking nailing and found that it is a safe technique regarding consolidation rate with advantages regarding mobilisation of upper limb. Careful suturing of rotator cuff and counter sinking of Proximal nail tip at the entrance point is a prerequisite in avoiding permanent lesions of the rotator cuff and shoulder pain.

Mc Cormack and Colleagues[36] conducted a study at the University of Calgary, compared DCP and intramedullary nailing in 44 cases of acute humeral shaft fractures. They achieved bony union in all but 1 case in DCP group. Non-union was seen in 2 cases of interlocking nailing group. They concluded that plating remains the best surgery for diaphyseal

fractures of humerus. Interlocking nailing is best indicated in specific situations.

Chapman[37] found that there was no significant difference in shoulder pain, function scores, range of motion and strength. Ante grade insertion of nail when performed correctly is not the main reason for shoulder joint impairment after intramedullary nailing.

In a retrospective study conducted by Cox and Dolan[38] found that 4 cases of non-union and 4 delayed union out of 37 cases and concluded that the indications and rationale for intramedullary humeral nailing should be clearly defined.

Dykes and Daryll[39] reviewed 49 cases following plate osteosynthesis of humeral shaft fractures and found no complications as a result of surgery and concluded open reduction and compression plating remains the treatment of choice for non-pathological humeral shaft fractures.

In a study conducted by Niall and Colleagues[40] in 49 cases treated by plate osteosynthesis of humeral shaft fractures and concluded that open reduction and compression plating remains the treatment of choice for non-pathological humeral shaft fractures that require operative intervention.

A Study was conducted by Farragos and Schemitsch[41] on complications with locked humeral nail and to discuss the prevention and management of these complications. They concluded that advantages of locking humeral nails are many and complications diminish their usefulness. And at present, open reduction and compression plating remain the treatment of choice for humeral shaft fractures.

Chen and Andrew[42] Compared fixation stability in humeral fractures fixed with intramedullary nail or DCP in human cadaver during cyclic and

physiologic loading and concluded that fixation with a gap both in nailing and plate fixation offer similar fixation stability during physiologic loading, with similar stiffness and no difference in displacement as function of applied load or cycling. However, intramedullary fixation has 50% greater failure than compared to plate fixation.

Demirel and Colleagues[43] in 2005 conducted a retrospective study of 114 humeral shaft fractures with interlocking nailing and came to conclusion that nailing is superior to plating for rate of union, shoulder and elbow function, operating time, soft tissue dissection, requirement of bone grafting, external immobilisation and stressed the importance of nailing in communised, segmental and in polytrauma patients.

Virkus and Walter[44] at Rush University, Chicago, compared the compressive force generated by plating and nailing in transverse diaphyseal humeral fracture model and concluded humeral nail can generate higher compression than plating using eccentric drill holes or the articulated tensioner when used with a short stainless steel screwdriver shaft.

ANATOMY

The shaft of the humerus, expands above into an upper end whose articular surface looks up and back. The lower part of the shaft curves gently forwards to a flat lower end projected into medial and lateral epicondyle, between which lies the articular surface of the elbow joint. The medial epicondyle projects in the same direction as the articular surface of the head and is much more prominent than the lateral epicondyle.
The humerus at rest lies with its articular head facing backwards as well as medially.

The glenoid cavity of scapula articulates with upper end of the humeral head. The head forms about one third of a sphere and is about four times the area of the glenoid cavity.The articular margin of the head is the anatomical neck of the humerus. Below the necks are the greater and lesser tuberosities separated by the bicipital groove.The lesser tuberosity projects prominently forwards, and is continued downwards as the medial lip of the bicipital groove. An undulating area of smooth bone indicates theinsertion of the tendon of subscapularis.

The greater tuberosity is bare bone, perforated by vessels, except at its projecting junction with the head. Here three smooth facets receive the tendons of scapular muscles. Superiorly is the facet for supraspinatus. Behind this lies a smooth facet for infraspinatus, while posterior the lowest facet receives teres minor. Below this tendon the bare bone lies in contact with the axillary nerve and its vessels. The lateral lip of the bicipital groove extends down from the anterior margin of the greater tuberosity to run into the anterior margin of the deltoid tuberosity.

The deltoid tuberosity is a V-shaped prominent ridge, with a smaller ridge in
between giving attachment to the fibrous septa in the multipennate acromial fibers of the deltoid.

Below the deltoid tuberosity the lower end of the radial groove spirals down. The posterior margin of the groove runs down as the lateral supra condylar ridge and curves forwards into the lateral epicondyle.

The lateral supra condylar ridge gives attachment to the lateral intramuscular septum.

The medial lip of the bicipital groove continues down into the medial supracondylar ridge, which at its lower end curves into the prominent medial epicondyle. The medial supracondylar ridge gives attachment to the medial intermuscular system. Level with the lower part of the deltoid tuberosity the nutrient foramen, directed down towards the elbow lies just in front of this medial border of the humerus.

Above the foramen, opposite the deltoid tuberosity, coracobrachialis is inserted. Flexor surface of the humerus, between the supracondylar ridges, gives origin to the brachialis muscle. Behind and below the deltoid tuberosity is the spiral groove, which accommodates the radial nerve.

Lower end of the humerus carries the articular surface for the elbow joint and is projected into medial and lateral epicondyles for attachment of muscles for the flexor and extensor compartment of the forearm.

The articular surface, coated with hyaline cartilage, shows the conjoined capitulum and trochlea.

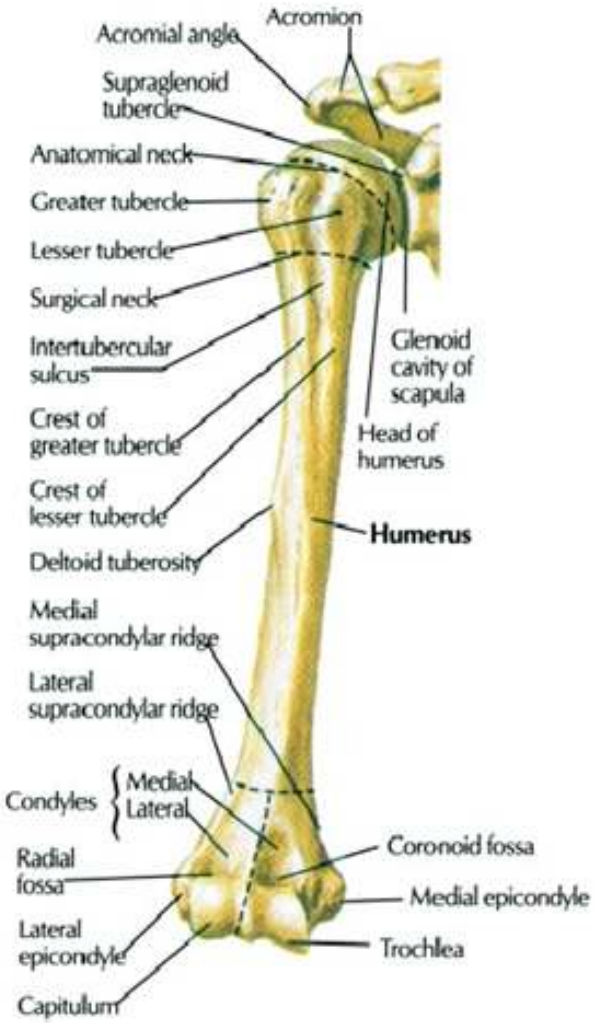
The capitulum articulates with the head of the radius. The pulley shaped trachlea articulates with the trochlear notch of the ulna.Above the capitulum is the radial fossa, which receives the head of radius when elbow is flexed.

Above the trochlea anteriorly is the coronid fossa, which during flexion receives the coronoid process of the ulna. Above the trochlea posteriorly is the olecranon fossa, which receives the olecranon process of the ulna when the elbow is extended.

The upper arm is enclosed in sheath of deep fascia. Two fascial septa, one on the medial side and one on the lateral side, extend from this sheath and are attached to the medial and lateral supracondylar ridges of the humerus respectively.

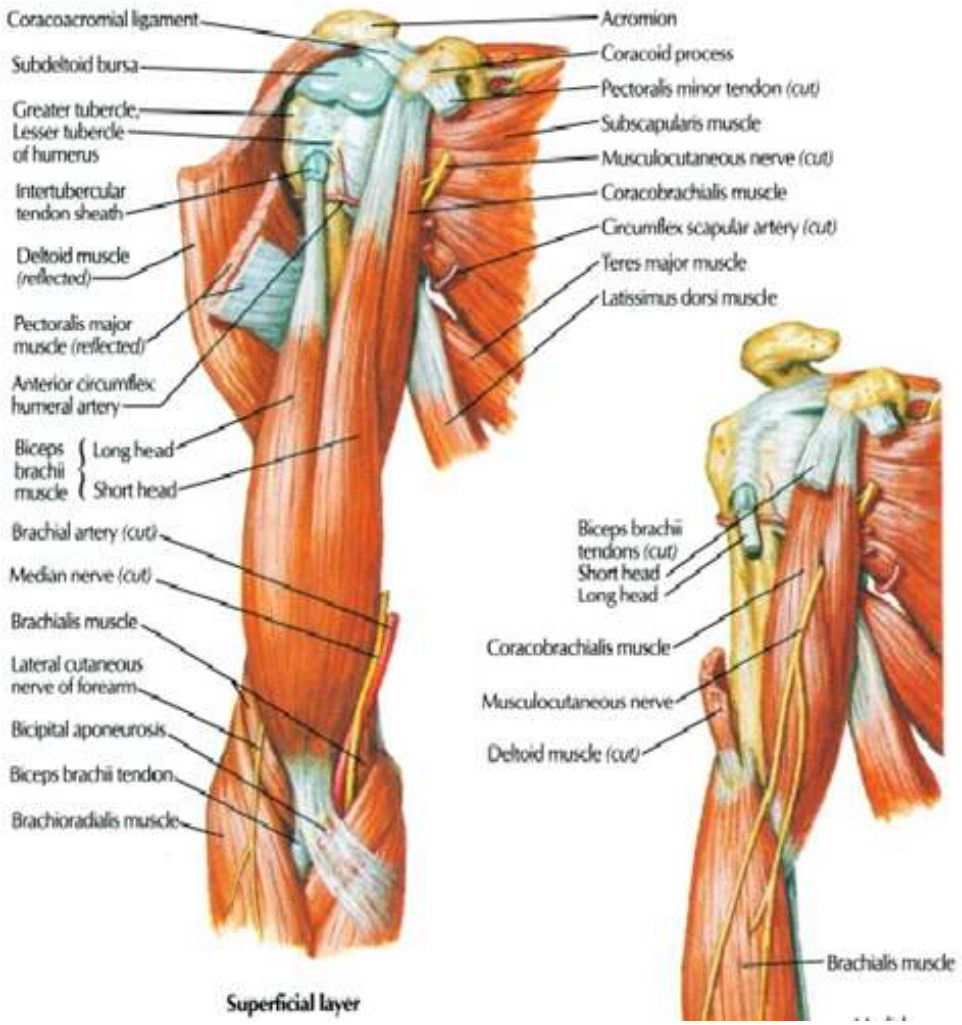
Thus the upper arm is divided into an anterior and a posterior fascial compartment each having its muscles, nerves and arteries.

OSTEOLOGY


Acromion
Acromial angle
Supraglenoid tubercle
Anatomical neck
Greater tubercle
Lesser tubercle
Surgical neck
Intertubercular sulcus
Crest of greater tubercle
Crest of lesser tubercle
Deltoid tuberosity
Medial supracondylar ridge
Lateral supracondylar ridge
Condyles
Medial
Lateral
Radial fossa
Lateral epicondyle
Capitulum
Glenoid cavity of scapula
Head of humerus
Humerus
Coronoid fossa
Medial epicondyle
Trochlea


posterior view
Acromion
Greater tubercle
Head of humerus
Anatomical neck
Surgical neck
Infraglenoid tubercle
Deltoid tuberosity
Humerus
Radial groove
Medial supracondylar ridge
Medial epicondyle
Lateral supracondylar ridge
Olecranon fossa
Lateral epicondyle
Trochlea
Groove for ulnar nerve

MUSCLES OF ANTERIOR COMPARTMENT OF ARM



Muscles of the anterior compartment of the arm are:

1. Bicepsbrachii:

The biceps brachii has two heads of origin.

a. Long head from the supraglenoid tubercle of the scapula.

b. Short head from the tip of the coracoid process.

The tendon of the long head crosses the humeral head within the capsule of the shoulder joint and emerges from the joint surrounded by a synovial sheath and lying in the bicipital groove of the humerus. It is joined in the Middle of the upper arm bythe short head.

The biceps brachii is inserted as an aponeuritic band called bicipital aponeurosis into the posterior part of tuberosity of the radius and also into deep fascia on the medial aspect of forearm.

Nerve supply of biceps brachii is by the musculocutaneous nerve.

Action: It is the prime supinator of the flexed forearm. It also flexes the elbow joint.

2. Coraco Brachialis:

It takes origin from the tip of the coracoid process and is inserted into the Middle of the medial side of the shaft of the humerus. It is supplied by the musculocutaneousnerve.

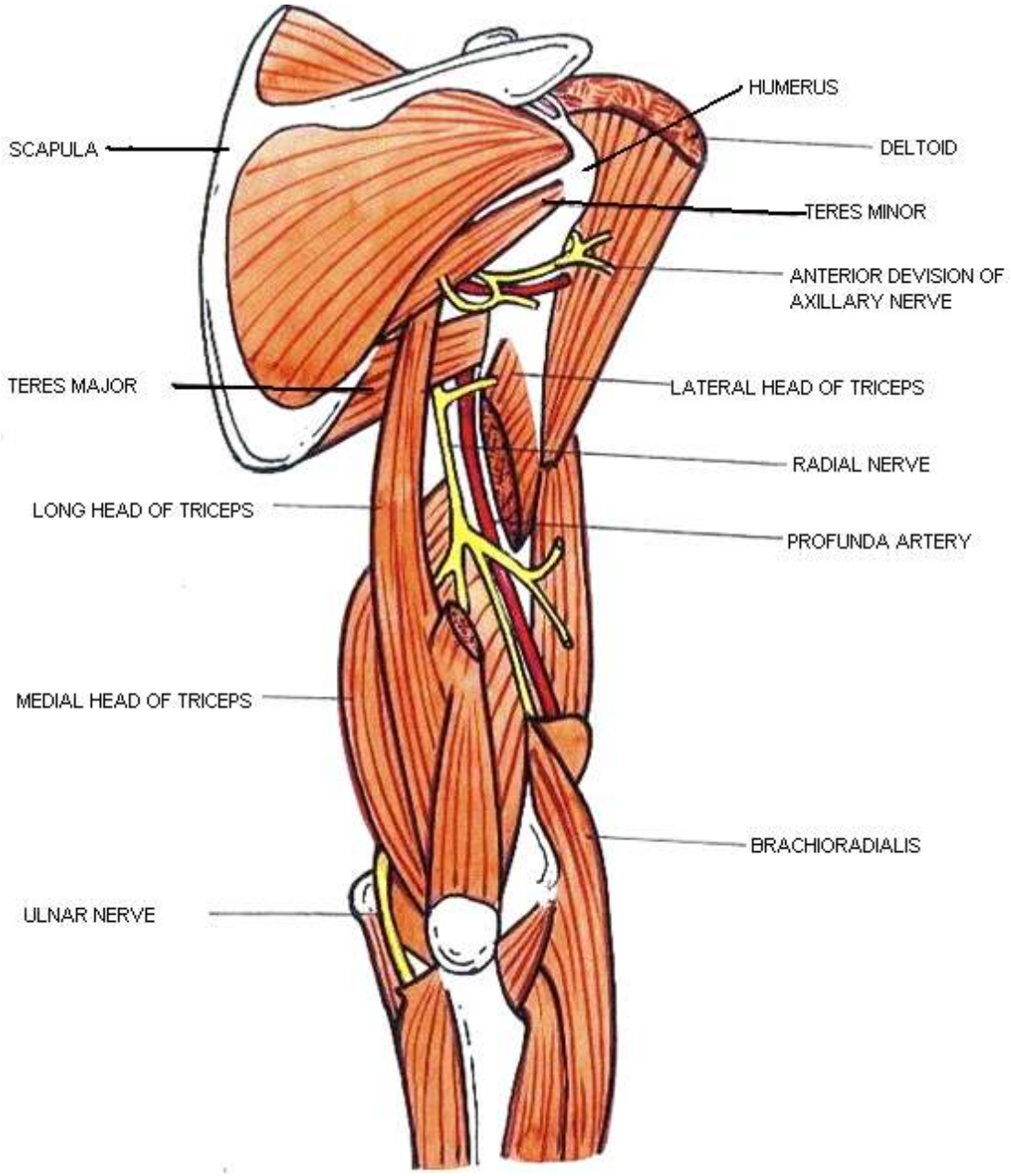
Action: It flexes the arm and is also a weak adductor.

3. Brachialis:

It takes origin from the anterior surface of the shaft of lower half of the humerus.

It is inserted into the anterior surface of the coronoid process of the ulna.It has got dual nerve supply. The major bulk of the muscle that arises in front of deltoid tuberosity is supplied by musculocutaneous nerve and part of the muscle that arises behind the tuberosity is supplied by the radial nerve.

Action: It is a strong flexor of the elbow joint.



The Posterior Compartment of the Arm:

Muscles of the post compartment of arm:

Triceps

It has three heads of origin:

-Long head from the infraglenoid tubercle of the scapula.

-Lateral head from the upper half of the posterior surface of the shaft of humerusabove the spiral groove,

-Medial head from the posterior surface of the lower half of the shaft of the humerus below the spiral groove.

The common tendon is inserted into the upper surface of the olecranon process of the ulna. It is supplied by the radial nerve.

Action: Triceps is the strong extensor of the elbow joint.

Blood supply of the posterior fascial compartment of the arm is by the Profundabrachii and ulnar collateral arteries

Blood supply to the anterior compartment of the arm is by the brachial artery.

Course of the brachial artery in the arm:The brachial artery, a continuation of the axillary artery, begins at the inferior border of the tendon of teres major and ends about a centimeter Distal to the elbow joint by dividing into radial and ulnar arteries.

Relations:

The artery is wholly superficial, covered anteriorly by skin, superficial and deep fascia. The bicipital aponeurosis crosses it anteriorly at the elbow. The median nerve crosses it lateromedially near the insertion of corachobrachialis.

Posterior are: the long head of triceps, separated by the radial nerve and Profunda brachii artery and then successively by: the medial head of triceps, the attachment of coracobrachialis and the brachialis.

Lateral are: Proximally the median nerve and corachobrachialis and Distally the biceps.

Medial are: Proximally the medial cutaneous nerve of the forearm and ulnar nerve, Distally the median nerve and basilic vein.

Branches:

1. Muscular branches to the anterior compartment of the arm.
2. The nutrient artery of the humerus.
3. ProfundaBrachii artery arises near the beginning of the brachial artery and follows the radial nerve into the spiral groove of the humerus.
4. Superior ulnar collateral artery arises near the Middle of the arm and follows the ulnar nerve.
5. Inferior ulnar collateral artery arises near the termination of the artery and takes part in the anastomosis around the elbow joint.

Course of the Median Nerve in the Arm:

The median nerve has two roots from the lateral (C 5, 6, 7) and medial (C8, T1) cords, which embrace the third part of the axillary artery, uniting anterior or lateral to it. The median nerve enters the arm at first lateral to the brachial artery, near the insertion of coracobrachialis it crosses in front of the artery, descending medial to it to the cubital fossa where it is posterior to the bicipital aponeurosis and anterior to the brachialis separated by the latter form the elbow joint.

Branches in the Arm:

These are vascular branches to the brachial artery and usually a branch to the pronator teres, a variable distance Proximal to the elbow joint.

Course of the Ulnar Nerve in the Arm:

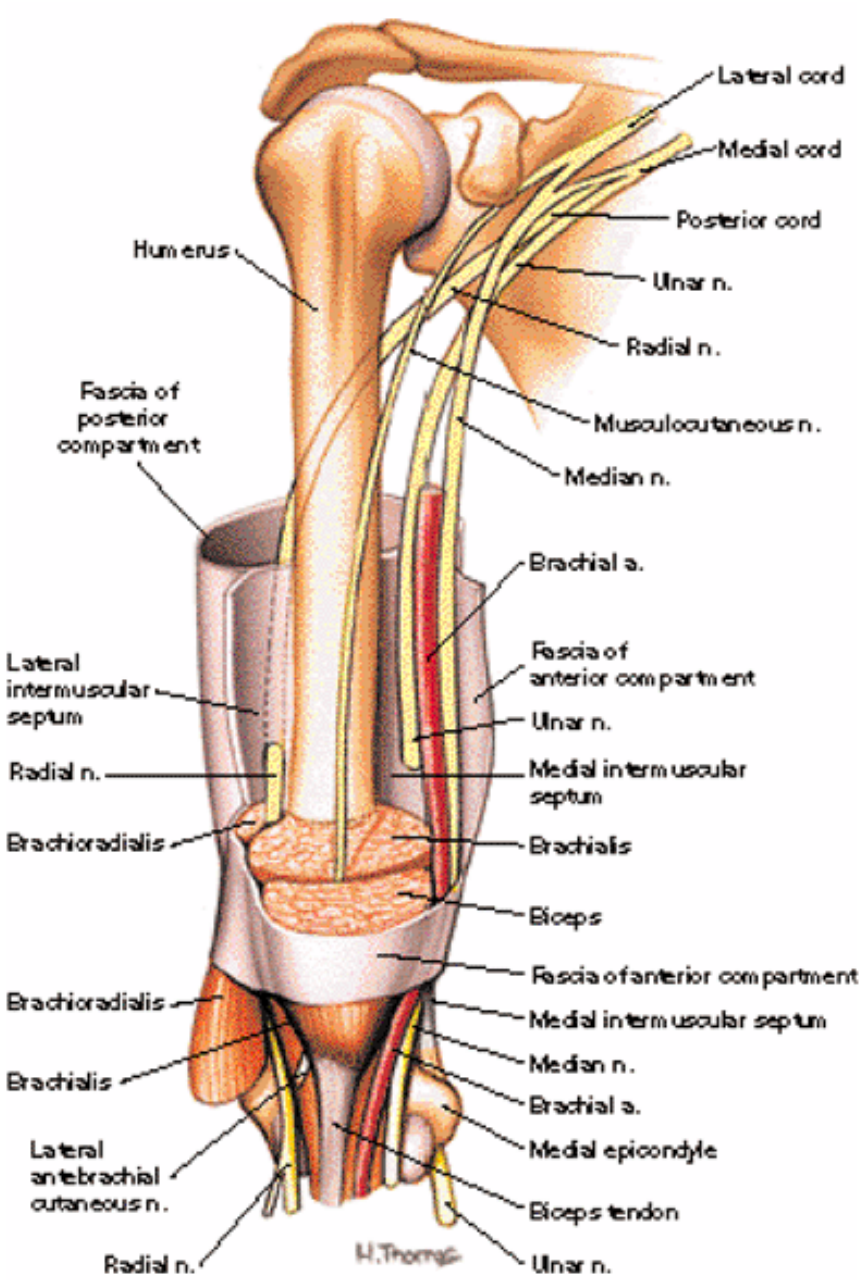
The ulnar nerve arises from the medial cord (C8, T1). It runsDistally through the axilla medial to the axillary artery and between it and the vein, continuing Distally medial to the brachial artery as far as the midarm, here it pierces the medial intermuscular septum, inclining medially as it descends anterior to the medial head of the triceps to the interval between the medial epicondyle and the olecranon, with the superior ulnar collateral artery.

Course of the Radial Nerve in the Arm:The radial nerve arises from the posterior cord C5, 6, 7, 8, T1. The largest branch of the brachial plexus, it descends behind the third part of the axillary artery and the upper part of the brachial, anterior to the subscapularis and the tendons of the latissmusdorsi and teres major with the arteriaProfundabrachii and later, its radial collateral branch, it inclines dorsally between the long and medial

heads of the triceps, after which it passes obliquely across the back of the humerus, first between the lateral and medial heads of the triceps, then in a shallow groove deep to the lateral head. On reaching the lateral side of the humerus it pierces the lateral intermuscular septum to enter the anterior compartment, it then descends deep in a furrow between the brachialis and Proximally the brachio-radialis, then more Distally the external carpi radialislongus.

Muscular branches:

Medial muscular branches arise from the radial nerve on the medial side of the arm. They supply the medial and long head of triceps.A large posterior branch arises from the nerve as it lies in the humeral groove. It divides to supply the medial and lateral heads of triceps and the anconeus. Lateral branch arise in front of the lateral inter muscular septum. They supply the lateral part of the brachialis, brachioradialis and extensor carpi radialislongus.



Radial nerve course in arm:

Cutaneous branches:

-Posterior and lower lateral cutaneous nerve of the arm.

-Articular branches to the elbow joint.

CLASSIFICATION

There is no universally accepted classification for humeral shaft fractures. Classically they have been classified on the basis of factors that influence treatment like Fracture location –

Based on the part of the diaphysis involved it is classified as

1. Proximal third
2. Middle third.
3. Distal third.

Based on the relation of the fracture line to the muscle insertion

1. Proximal to pectoralis major insertion.
2. Distal to pectoralis major insertion but Proximal to deltoid insertion.
3. Distal to deltoid insertion.

Direction and character of fracture line -

1. Transverse.
2. Oblique.
3. Spiral.
4. Segmental.
5. Comminuted.

Associated soft tissue injury –

Open fractures / closed fractures.

Associated periarticular injury –

glenohumeraljointor elbow joint.

Associated nerve injury–

Radial,Median or Ulnar nerves.

Associated vascular injury –

Brachial artery or vein.

Intrinsic condition of bone –

Normal / Pathologic.

This classification has prognostic value because higher fracture types have greater risk as they are high energy fractures.

AO CLASSIFICATION

A1 Simple fracture, spiral

1. Proximal zone
2. Middle zone
3. Distal zone

A2 Simple fracture, oblique (> or = 30°)

1. Proximal zone
2. Middle zone
3. Distal zone

A3 Simple fracture, transverse (< 30°:)

1. Proximal zone
2. Middle zone
3. Distal zone

B1 Wedge fracture, spiral wedge

1. Proximal zone
2. Middle zone
3. Distal zone

B2 Wedge fracture, bending wedge

1. Proximal zone
2. Middle zone
3. Distal zone

B3 Wedge fracture, fragmented wedge

1.Proximal zone

2.Middle zone

3.Distal zone

C1 Complex fracture, spiral

1. with two intermediate fragments

2. with three intermediate fragments

3. with more than three intermediate fragments

C2 Complex fracture, segmental

1. with one intermediate segmental fragment

2. with one intermediate segmental and additional wedge fragment(s)

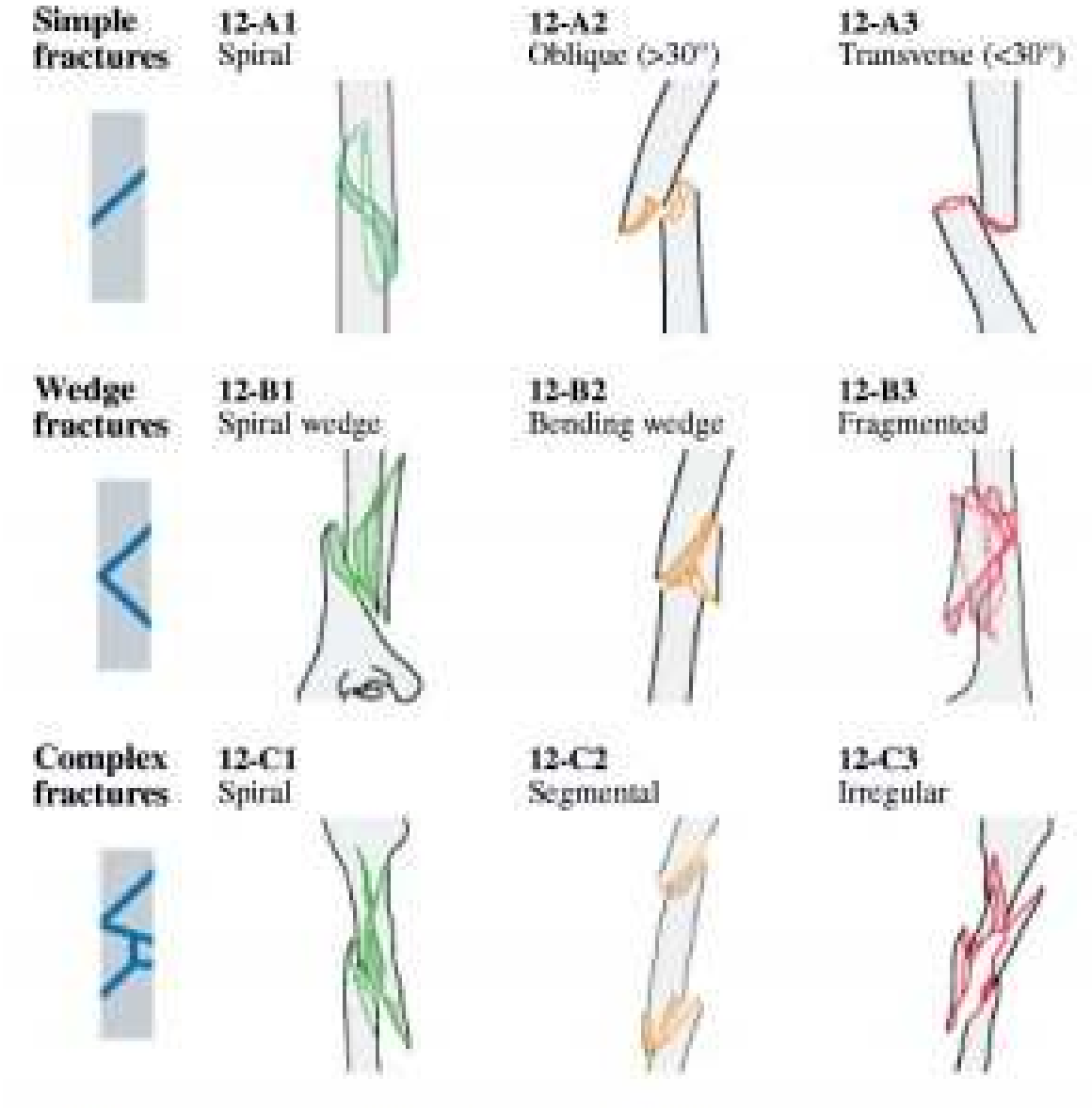
3. with two intermediate segmental fragments

C3 Complex fracture, irregular

1. with two or three intermediate fragments

2. with limited shattering (< 4 cm)

3. with extensive shattering (> or = 4 cm)



AO CLASSIFICATION OF HUMERUS FRACTURES

Classification of the fracture guides us in choosing the treatment modality.A simple oblique fracture yields good results with conservative management. A transverse fracture precludes the use of hanging arm cast due to risk of distraction and potential complications. Spiral fractures in the Distal third also called as Holstein - Lewis fracture is often complicated by Radial nerve palsy either primarily or post closed reduction.Segmental fractures usually need internal fixation. Comminuted fractures are better managed by closed means. Osteopenic bones are better managed by intramedullary nailing than by plating.

EVOLUTION OF INTRAMEDULLARY NAILS

Historical evolution of intramedullary nail dates back to 16th century, where resinous wooden plugs were used as intramedullary devices for the treatment of non-union of humerus fractures by **Incas** and **Azloca**. Ivory pegs were used by Bircher and others in 1886. **Hoglun** used bone rather than ivory pegs in 1917.

In the beginning of the 20th century, **Ernest Hey Groves** (England) used three- or four-edged intramedullary nails for the fixation of diaphyseal long bone fractures.

Smith – Petersen introduced a nail in 1920's to fix subcapital femoral fractures

In 1940**, Lambrinudi** suggested the placement of strong wires and thin metal sticks through the medullary canal. This method was later upgraded by the Rush brothers.**Rush** and **rush** reportedly used intramedullary steinmann pin for the treatment of compound monteggia fracture.

A new pin with a collor at the Proximal extremity was used in the treatment of humeral fractures.

In 1950's ,two important techniques were developed. In 1942**,Fischer** reported the use of intramedullary reamers to increase the contact area between the nail and the host bone.

Kuntscher introduced the flexible reamers and they believed that reaming along with larger diameter nail would enhance the stability of fractures by increasing the contact area. He also felt that although intramedullary vascular supply was obliterated by this the periosteum and surrounding tissues would promote adequate bone formation for healing.

Kuntschner and klemm originated the term interlocking in 1980 and produced extensive development in nailing.

Locking nailing took precedence over other methods in 1980 but interlocking methods were very difficult and time consuming with difficulty in inserting the Distal locking screws.

The brooker- willis nail which had fins removed this disadvantage by avoiding Distal locking never gained popularity.

Closed nails with rush nail and enders nails gained popularity for humeral fractures. The major advantage is these pins can be inserted without damaging the rotator cuff.

Gallaher and mouradain produced newer humeral nails in 1985. Several Distal locking devices were produced one with LASER claiming 97% accuracy.

The marchettis nail was introduced in 1986, was to be inserted by supraolecranon approach and gained good outcome.

In the 1990s, the major advancements came with the expansion of indications for unreamed and reamed intramedullary nailing.

EFFECTS OF REAMING

Reaming has a significant biologic and mechanical impact on the physiology
of fracture healing. Intramedullary reaming causes destruction of the contents of the marrow Cavity (Blood vessels and marrow). The principal nutrient artery is damage during intramedullary reaming.

The medullarycanal is irregular in both longitudinal and cross sections. For a stable intramedullary fixation a firm fit is needed.The process of reaming is for centralizing the nail and also produces a larger contact area between the nail and bone thereby increases the stability of fixation. Reaming allows insertion of larger diameter , stronger nail and reaming can stimulate fracture healing by providing a source of autologous bone graft from the reamed particles at the fracture site.

Outcome studies consistently show that reaming potentiates the healing
response with intramedullary fixation of long-bone fractures. Recent laboratory studies implicate alterations in cortical blood flow patterns andtheosteogenic potential of reaming debris as critical components of this process.

COMPLICATIONS OF REAMING

Thermal necrosis is a rarebut commonly referenced complication of reaming. The risks of heat-induced cortical damage can be minimized by sequential reaming with sharp instruments and by reaming with instruments that are sized appropriately to fit the intramedullary canal. Reaming results in increased intramedullary pressure and secondary embolization of marrow elements to the pulmonary system.

Points to reduce the complication while reaming

1. Avoid reamers with blunt flutes.
2. Always start with the end cutting reamer
3. Reamers should be with deep flutes to facilitate passage of medullary contents
4. Advancement of the reamer must be slow with reamer rotating at full speed.
5. Distal vent can be used to lower the medullary pressure.

BIOMECHANICS OF IM NAILING

The intramedullary nail or rod is commonly used for long-bone fracture fixation particularly diaphyseal and selected metaphyseal fractures. These implants are introduced into the bone remote to the fracture site and share compressive, bending, and torsional loads with the surrounding osseous structures. Intramedullary nails function as internal splints that allow for secondary fracture healing, A nail is subject to fatigue and can eventually
breakif bone healing does not occur.

The basic principle of Intramedullary nailing is “Dynamic Osteosynthesis”. Intrinsic characteristics that affect nail biomechanics include its materialproperties, cross-sectional shape, anterior bow, and diameter. Extrinsic factors, such as reaming of the medullary canal, fracture stability (comminution), and the use and location of locking bolts also affect fixation biomechanics.

Although reaming and the insertion of intramedullary nails can have early deleterious effects on endosteal and cortical blood flow, canal reamingappears to have several positive effects on the fracture site, such as increasing extraosseous circulation, which is important for bone healing. Interlocking produces positive fixation with both Proximal and Distal locking produces fixation of communited, segmental more Proximal and Distal humeral fractures. Statically locked nail do not allow gliding of the nail within the bone and controls both axial shortening and rotation. Dynamic locking refers to nails with either Proximal or Distal locking screws. Dynamically locked nail do not allow gliding of the nail within the bone.

EVOLUTION OF PLATES

Metal fixation for internal fixation of fractures have been used for more than100 years.Lane first introduced a metal plate in 1895 for internal fixationwhich was eventually abandoned owing to problems with corrosion.Lambotte in 1902 and Sherman in 1912 introduced their versions of plates which had improvements in metallurgical formulation which increased corrosive resistance but both were eventually abandoned as a result of their
insufficient strength.

Lambotte plate

The next important development in fracture plate design was initiated by Eggers in 1948 with two long slots which allowed screw heads to slide. The use of this plate was limited by its structural weakness and the resultant instability of its fixation. Danis in 1949 recognized the need for compression between the fracture fragments and introduced a plate he called the coapteur, which suppressed the interfragmentary motion and increased the stability.

Danis plate

In 1958 Bagby and Janes designed a plate with oval holes which allowed interfragmentary compression while tightening the screws. Muller et al. permitted interfragmentary compression by using a tensioner that was temporarily anchored to the bone and the plate.

Tensioner device

Dynamic Compression Plate (DCP) has specially designed oval holes similar to Bagby and Janes invention to compress bony fragments duringscrew tightening.

Dynamic Compression Plate

Advantages:

1. Low incidence of malunion
2. Stable internal fixation
3. No need for external immobilization
4. Early mobilization of neighbouring joints

The Swiss group developed a plate design to reduce the plate's interference with cortical perfusion and decrease cortical porosis which is called as Limited Contact – Dynamic Compression Plate (LC-DCP).

The concept of biological osteosynthesis led to the development of the Point contact fixator (PC-FIX),which abandoned interfragmentary compression

andbicortical fixation.

CLASSIFICATION OF PLATES

A bone plate has two mechanical functions

1. Transmits forces from one end of the bone to the other, bypassing and thus protecting the area of fractures.
2. Holds the fractures ends maintaining the proper alignment throughout the
healing process.

Regardless of their length, thickness, geometry and configuration, all plates are classified into

1. Neutralization plate
2. Compression plate
3. Butress plate
4. Condylar plate

1. Neutralization Plate:

A Neutralization plate acts as a “bridge”. Its main function is to act as a mechanical link between the healthy segments of bone above and below the fracture.It does not produce any compression at the fracture site.

The most common clinical application of this plate is to protect the screw fixation of a short oblique fracture or butterfly fragment or for the fixation of a segmental bone defect in combination with bone grafting.

2. Compression Plate:

A compression plate produces a locking force across a fracture site to which it is applied.The effect occurs according to Newton’s third law.Thedirection of the force is parallel to the plate.

Compression can be Static or Dynamic.A plate applied under tension produces static compression at a fracture site.This compression is constant

when the limb is at rest or is functioning. Dynamic compression is a phenomenon by which the plate can transfer or modify functional physiological forces into compressive forces at the fracture site.When functional activity begins the physiological forces which are normally destabilizing for the fracture are converted to a stabilizing and active force by the same plate which now acts as a tension band.

3. Buttress Plate:

The mechanical function of this plate is to strengthen (buttress) theweakened area of the cortex.It prevents the bone from collapsing during the healing process. This plate applies a force to the bone which is perpendicular to the flat surface of the plate.It is mainly used to maintain the bone length or to support the depressed fracture fragments.It is commonly used in fixing epiphyseal and metaphyseal fractures.

4. Condylar Plate:

Its main application has been in the treatment of intra-articular Distal femoral fractures.It has two mechanical functions.

1. It maintains the reduction of the major intra-articular fragments thus restoring the anatomy of the joint surface.
2. Rigidly fixes the metaphyseal components to the diaphyseal shaft.

PRINCIPLE OF ABSOLUTE STABILITY USING PLATES

Absolute stability of plated fractures requires anatomical reduction andinterfragmentarycompression,which can be established by lag screws,axialcompression by plate or both. In most individuals, the humerus requires six cortices of screw purchase on each side.Static compression

between two fragments is maintained over several weeks and does not enhance bone resorption or necrosis.Fracture fragment interdigitation and compression reduces interfragmentary motion to nearly zero and allows for direct bony remodelling of the fracture (primary bone healing without callus).

Compression must sufficiently neutralize all forces (bending,tension,shear, and rotation) along the whole cross section of a fracture to achieve absolute stability.

There are four ways of achieving interfragmentary compression with a plate

1. compression with the dynamic compression unit in a plate
2. compression by contouring (overbending) the plate
3. compression by additional lag screws through plate holes
4. compression with the articulated tension device

GENERAL PRINCIPLES OF PLATE FIXATION

Successful use of a bone plate depends on the properties of the plate,thescrews,the bone and on the correct application of biomechanical principles.

Plate related factors

The strength of a plate depends on the thickness of the plate and the stiffness of the material which should be close to the bone

Screw related factors

The effectiveness of the screw depends on the Design of the thread

Screw head

A minimum of 6 cortices on each side of the fracture is necessary for a rigid fixation in humerus

Strength of the plate fixation depends on the holding power of the screws.

Bone related factors:

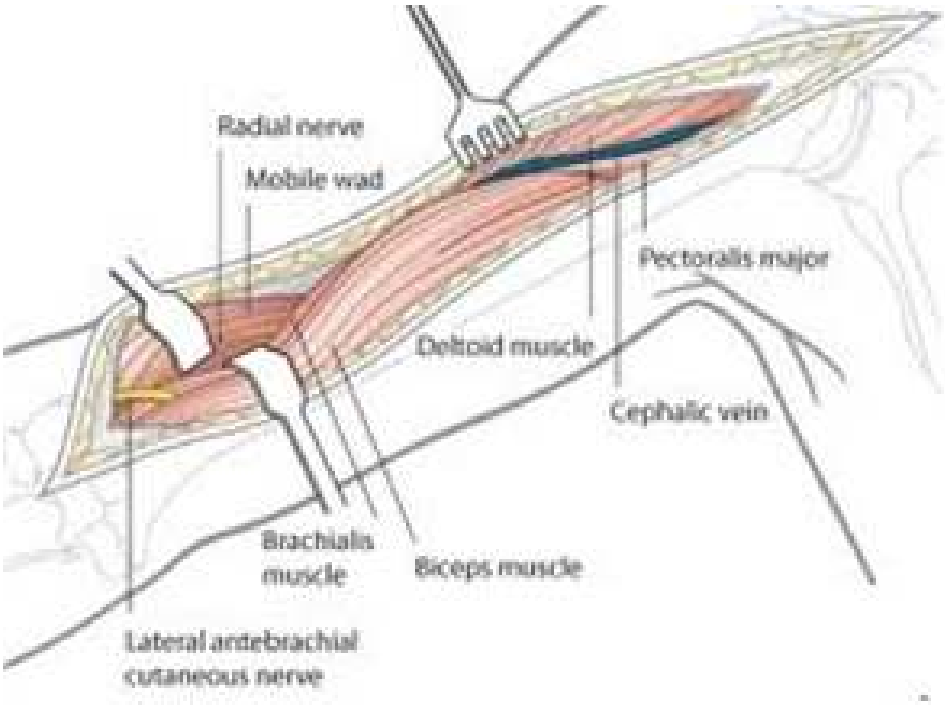
The health of the bone is an important factor as the holding power of the screw is dependent on the elastic force provided by the bone.

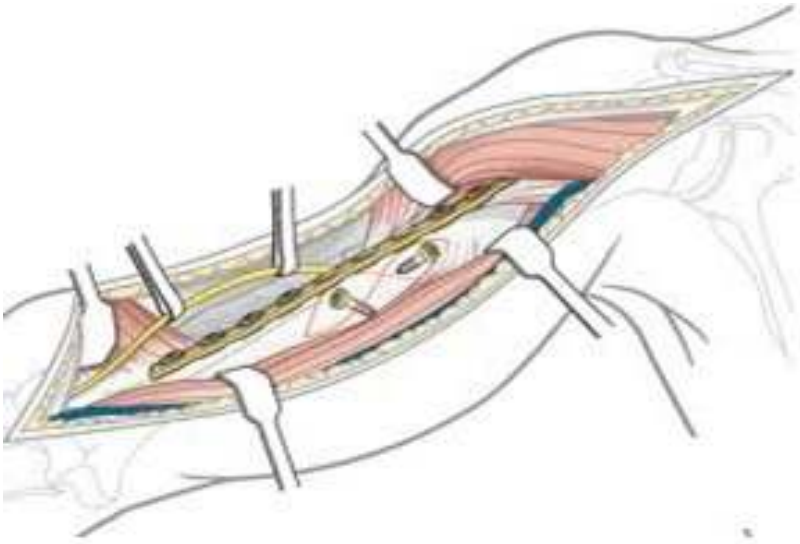
Construct related factors.

The strength of the construct will depend on the direction of the load andthe position of the plate. The plate applied on the tension side of the boneis a strong construct. It becomes strongest when two plates are applied right angles to each other.

The strength of the reconstructed bone depends on :

1. Strength of the plate and screw – design,dimension and material and purchase
2. Configuration of the fracture – comminution and placement of plate
3. Properties of the plate-bone construct – working length and load sharing





ANTEROLATERAL APPROACH OF HUMERUS

SURGICAL APPROACHES

ANTEROLATERAL APPROACH

Position of the patient

The patient is placed supine on the operating table with the arm lying on an armboard and abducted about 60°.

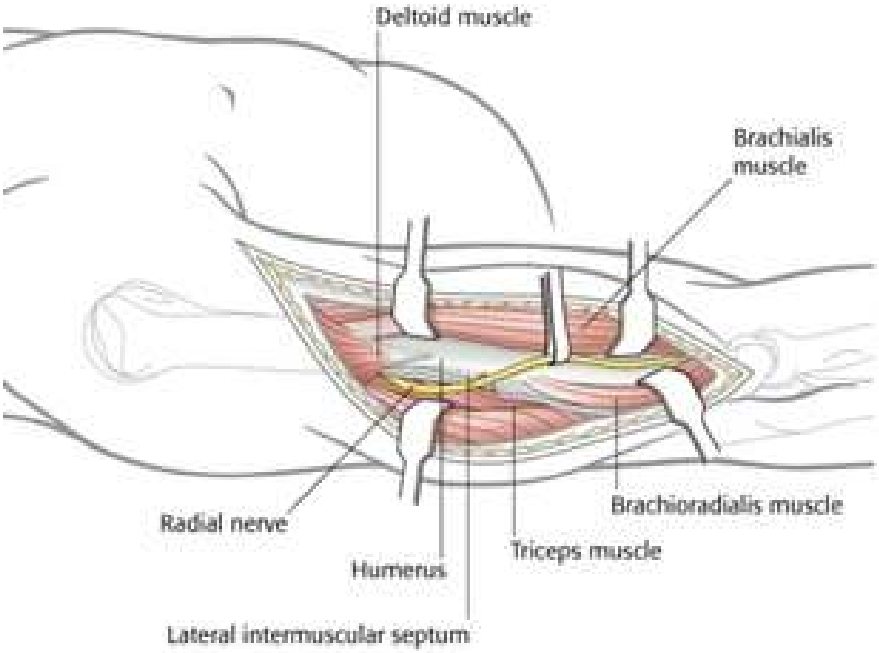
Incision

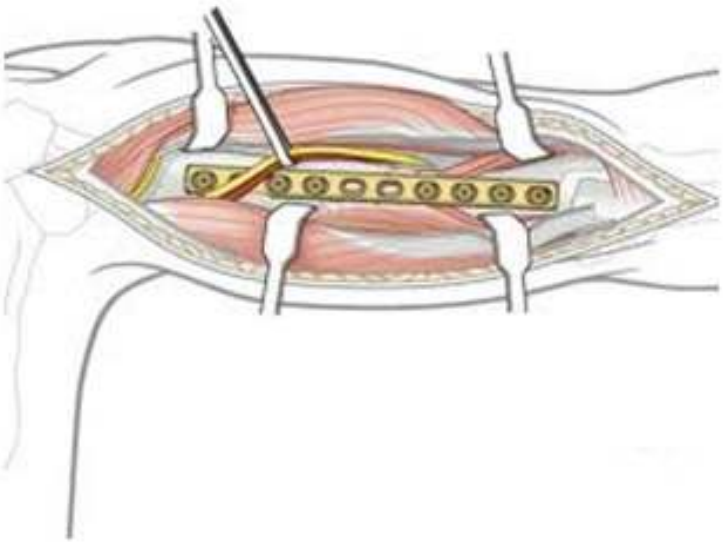
A curved longitudinal incision over the lateral border of the biceps starting about 10 cms Proximal to the flexion crease of the elbow.

Dissection

There is no internervousplane.Superficially, the biceps is retracted medially to reveal the brachialis and the brachioradialis and an intermuscularplane is developed between them.Radialnerve is identified between the muscles at the level of the elbow joint.It is retracted medially and the deep dissection is done by incising the lateral border of the brachialis and by lifting it off by subperiosteal dissection.

POSTERIOR APPROACH





POSTERIOR APPROACH OF HUMERUS

Position of the patient

The patient is placed either in lateral position with the affected side uppermost or in prone position with the arm 90° and the elbow allowed to bend and the forearm to hang over the side of the table.

Incision

A longitudinal incision in the midline of the posterior aspect of the arm, from 8 cms below the acromion to the olecranon fossa.

Dissection

There is no true inter nervous plane. Superficially to identify the gap between the lateral and long head of triceps, above the level where they fuse to form a common tendon . Proximally continue blunt dissection between the two heads and Distally it needs sharp dissection along the line of incision. Deeply, the medial head of triceps is incised in the midline, down to the periosteum and strip the muscle by epi-periosteal dissection.

MATERIALS AND METHODS

This is a prospective comparative study of 24 patients with humeral shaft fractures treated with Intramedullary interlocking nailing and Plate osteosynthesis done in the Department of Orthopedics, Government Stanley Medical College from June 2012 to September 2013.

INCLUSION CRITERIA

- Acute fractures of humeral shaft
- Patients aged above 18 years
- Fractures 2cm below surgical neck and 3 cm above olecranon fossa
- Multiple injuries
- Angulation more than 15 degrees

EXCLUSION CRITERIA

- Open physis
- Age less than 18 years
- Fractures involving Proximal 2 cmsand Distal 3 cms of the humeral Diaphysis

MANAGEMENT

All cases are initially assessed for head injury and other associated injuries.Initial management was done with U – slab till the patient is fit for surgery.

I

MPLANT USED FOR INTERLOCKING NAILING:

The nail used in our study is Tetramed intra medullary humeral nail. They are available in diametersof 6.0mm which are non cannulated solid nails and the 7.0mm,8.0mm cannulated nails. They can be inserted over 2.4 mm thick guide wire.The nails areavailable in various lengths starting from 160 mm onwards at increments of10mm . The Proximal locking is provided from lateral to medial direction. The Proximal locking are 2 in number and both are static for the 6.0mm solid nails and the Proximal being dynamic and Distal static for the 7.0mm cannulated nails. The Distal locking are in the antero posterior direction.

The nail size is measured with the full length x-ray from tip of greater tuberosity to 3cms above the Proximal tip of olecranon fossa.Clinically it is measured by subtracting 5 cms from the tip of acromian to the lateral epicondyle of humerus. The best method is by a scanogram . It is a must to have all nail sizes and appropriate instrumentation .It is mandatory to have the C- arm image intensifier and a good technician.

INSTRUMENTS USED FOR INTERLOCKING NAILING

INTERLOCKING NAILS

POSITIONING

INCISION

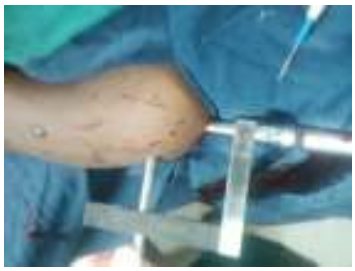
ENTRY WITH BONE AWL

GUIDE WIRE INSERTION

NAIL INSERTION

REAMING

DISTAL LOCKING



PROXIMAL LOCKING

ANTEGRADE HUMERUS NAILING BY CLOSED METHOD

POSITION OF THE PATIENT

The patient is positioned supine on a fracture table with a sand bag under the shoulder and the whole upper limb is prepared and drapped to keep the limb free.

ANAESTHESIA

General anaesthesia or Regional block

APPROACH

Through Lateral Deltoid Splitting approach with the image intensifier the entry point is made just medial to the greater tuberosity and in the area at junction between the articular surface of the head and greater tuberosity. After splitting the deltoid , the Rotator cuff is exposed and split at the tendon of the supraspinatus. The entry point reamer is used to make entry in humeral head just medial to greater tuberostiy.enlarged. 45 cms guide wire is introduced through the entry point and is passed into the Distal fragment. Closed reduction done under the guidance of C-arm image intensifier. Progressive reaming was done over the guide wire up to 1 mm more than the desired nail size.

Nail Insertion

The appropriate nail is mounted on the zig and inserted through the guidewire. The nail size should be carefully selected because over size nail may end up splintering the distal fragment.The nail is pushed to a level where the nail is not protruding out through the articular surface of the Proximal humerus.

Distal Locking

The size of nail are the 6mm non canullated, 7mm and 8 mm Cannulated nails.The Distal locking for the cannulated nail was 4.5 mm self tapping locking screws for which 3.00mm drill bits were used. The Distal locking are antero-posterior locking. Under image guidance a stab incision is made at the anterior aspect of forearm, the biceps and brachialis is split to expose the surface of the bone. Under image guidance appropriate drill bit is used and the distal screws are inserted.

Proximal Locking

This is done using the proximal jig that is mounted with the nail. Care must be used to avoid the axillary nerve. The Proximal locking are in the mediolateral plane.

Post–operative protocol:

Immediately after surgery the limb is supported with an arm sling. Woundinspection was done on 2nd post operative day. Suture removal on 12th post op day. Active elbow and shoulder exercises started on 3rdday under the supervision of the physiotherapist.

SURGICAL TECHNIQUE OF PLATE OSTEOSYNTHESIS

IMPLANTS USED

The most commonly used plate for fixation of humeral shaft fractures is the broad, 4.5-mm dynamic compression plate, occasionally, anarrow, 4.5-mm, DCP is used for smaller bones. For spiral or oblique fractures, the ideal construct consists of a lag screw with a neutralization plate, whereas transverse fractures are ideally suited for a compression plating technique.

PROCEDURE

ANAESTHESIA :

General or Regional Block

POSITION OF THE PATIENT:

Lateral position with elbow flexed over a pillow and forearm hanging by the side.

APPROACH

POSTERIOR APPROACH

Through posterior approach incision was made in midline upto the tip of olecranon in line with the humerus.The dissection is carried down to thetriceps fascia and the fascia is incised. The radial nerve is identified and freed Proximally and Distally to allow for mobilization.The triceps is incised off the periosteum and the fracture site is exposed.After the fracture ends are freshened, the fragments are reduced and held with bone clamps or with a lag screw. Then it is fixed with 4.5mm broad or narrow DCP in neutralization or compression mode.

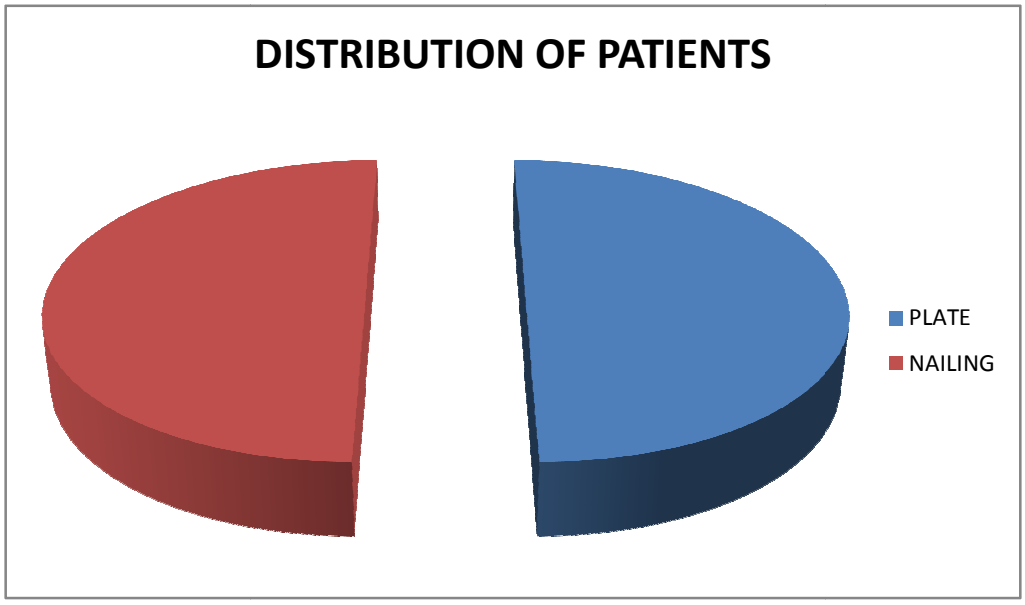
Post – Operative Protocol:Wound inspection done on 2nd post op day. Suture removal done on 12th day active shoulder and elbow started 3rdon to 4thday once the pain level decreases under physiotherapist guidance and tolerability of the patient.

OBSERVATION AND RESULTS

TABLE 1

DISTRIBUTION OF PATIENTS

PLATE OSTEOSYNTHESIS	INTERLOCKING NAILING	TOTAL
12(50%)	12(50%)	24(100%)

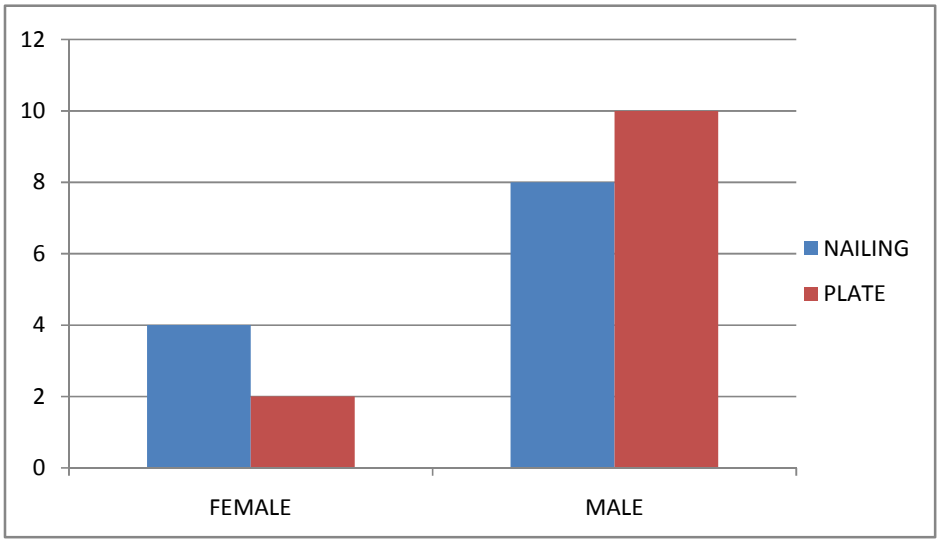


There were 24 patients who were randomly allotted to interlocking nailing group and to plate osteosynthesis group.

TABLE -2

SEX OF THE PATIENTS

	INTERLOCKING NAILING	PLATE OSTEOSYNTHESIS	TOTAL
FEMALE	4	2	6
MALE	8	10	18
TOTAL	12	12	24



DISTRIBUTION OF PATIENTS

TABLE 3

AGE OF THE PATIENTS

AGE	INTERLOCKING NAILING	PLATE OSTEOSYNTHESIS
21-40	8	4
41-60	3	6
61-80	1	2

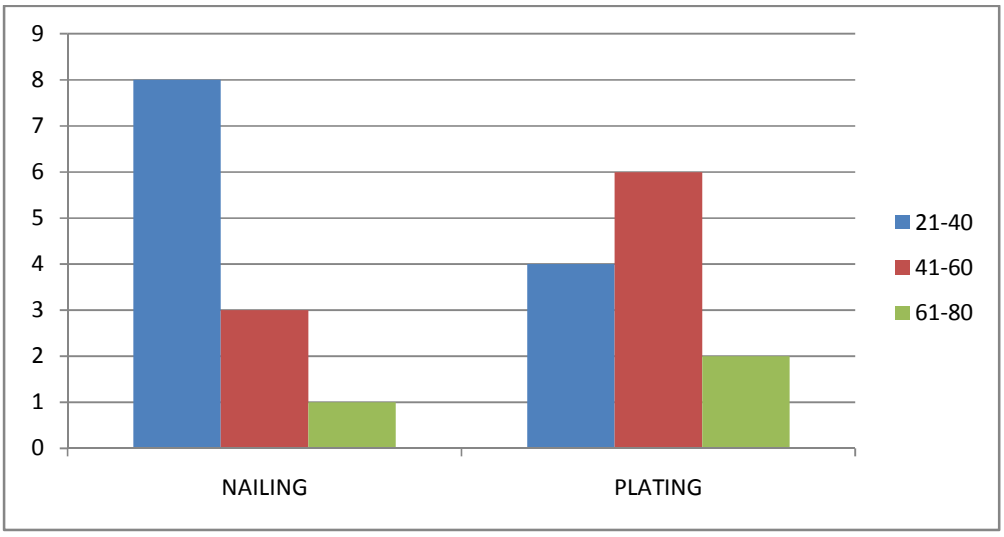
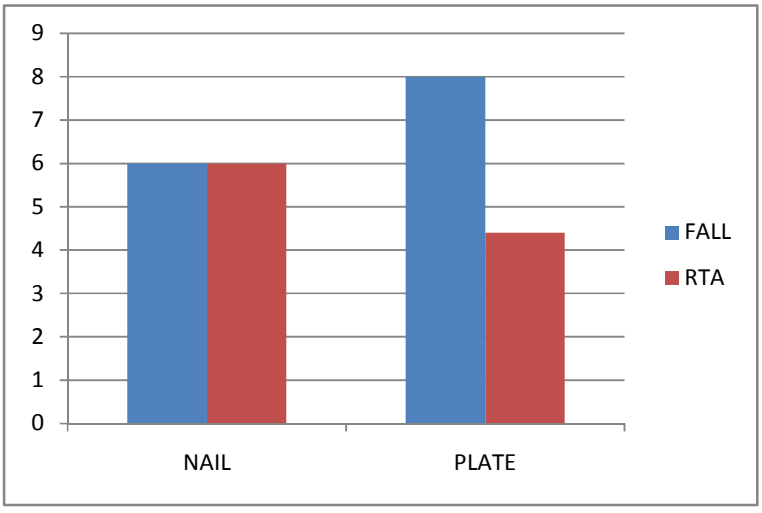


TABLE -4

MODE OF INJURY

	INTERLOCKING NAILING	PLATE OSTEOSYNTHESIS	TOTAL
ACCIDENTAL FALL	6	8	14
RTA	6	4	10
TOTAL	12	12	24

The majority of the cases in both groups were found to due to accidental fall (58%) and due to road traffic accidents (42%).

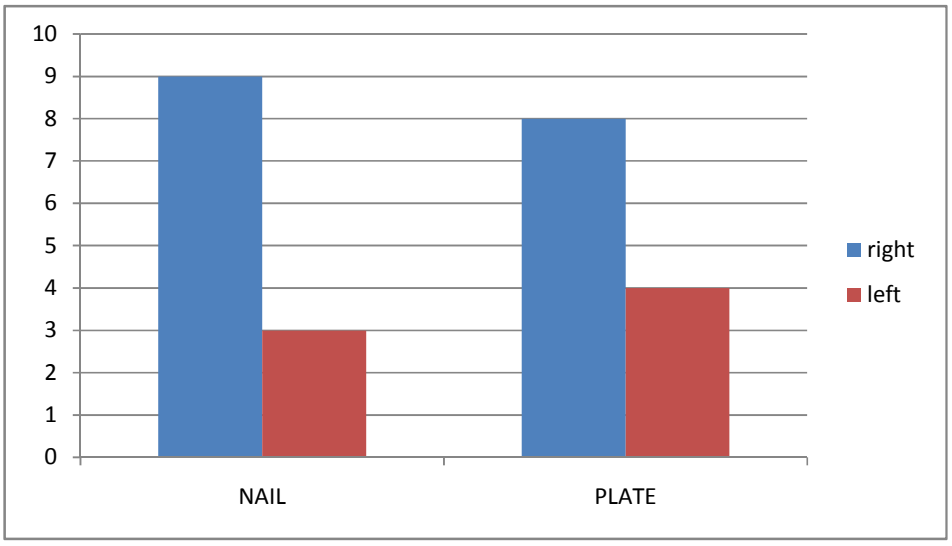


MODE OF INJURY

SIDE OF INJURY

TABLE -5

SIDE OF INJURY	NAIL	DCP	TOTAL
RIGHT	9(75%)	8(66.6%)	17(70.8%)
LEFT	3(25%)	4(33.3%)	7(29.1%)
TOTAL	12(100%)	12(100%)	24(100%)

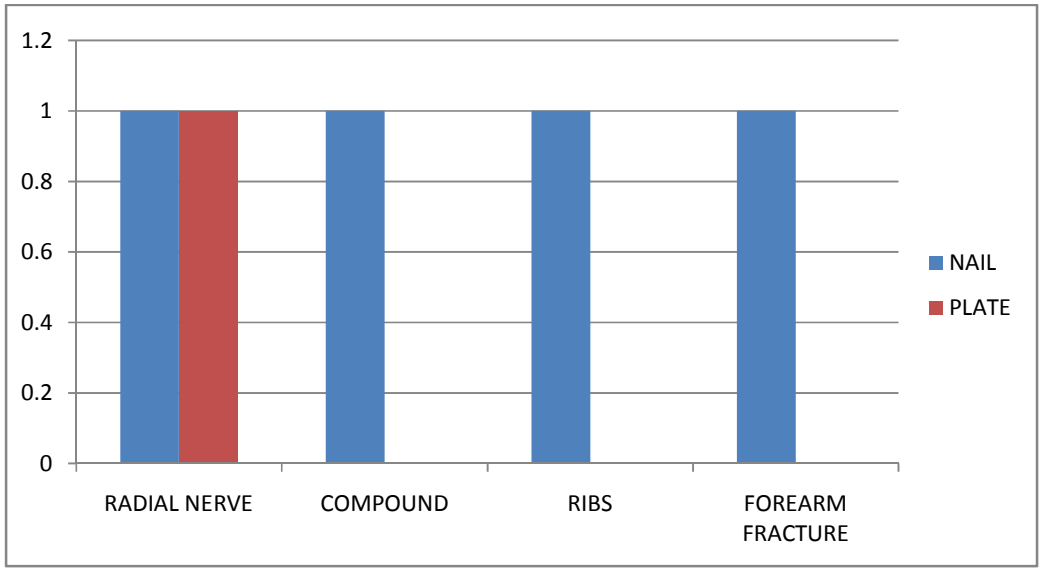


Right side was found to be involved in majority of cases 70% and left side involvement was found in only 29% of cases.

TABLE-6

ASSOCIATED INJURY

ASSOCIATED INJURY	Interlocking nailing	Plate osteosynthesis	Total
RADIAL NERVE PALSY	1(recovering)	1	2
FOREARM FRACTURE	1	0	1
CLAVICLE FRACTURE	0	0	0
RIB FRACTURES	1	0	1
COMPOUND INJURY	1(GRADE I)	0	1
TOTAL	4	1	5



The following factors were compared between plate osteosynthesis and interlocking nailing

1.Time taken for fracture Union

2.Functional outcome

3.Complications

1.Time taken for Fracture Union

TABLE-7

SI NO	SURGICAL PROCEDURE	TIME TAKEN FOR UNION		AVERAGE
		MINIMUM	MAXIMUM	
1	INTERLOCKING NAILING	16 WEEKS	28 WEEKS	22 WEEKS
2	PLATE OSTEOSYNTHESIS	16 WEEKS	24 WEEKS	20 WEEKS

The interlocking nailing group was found to have a minimum time for union of 16 weeks with a maximum of 28 weeks with an average time for union was at 22 weeks and for plate osteosynthesis group it was 16 weeks minimum and 24 weeks maximum with an average of 20 weeks.

3.FUNCTIONAL OUTCOME

RODRIGUEZ MERCHAN CRITERIA

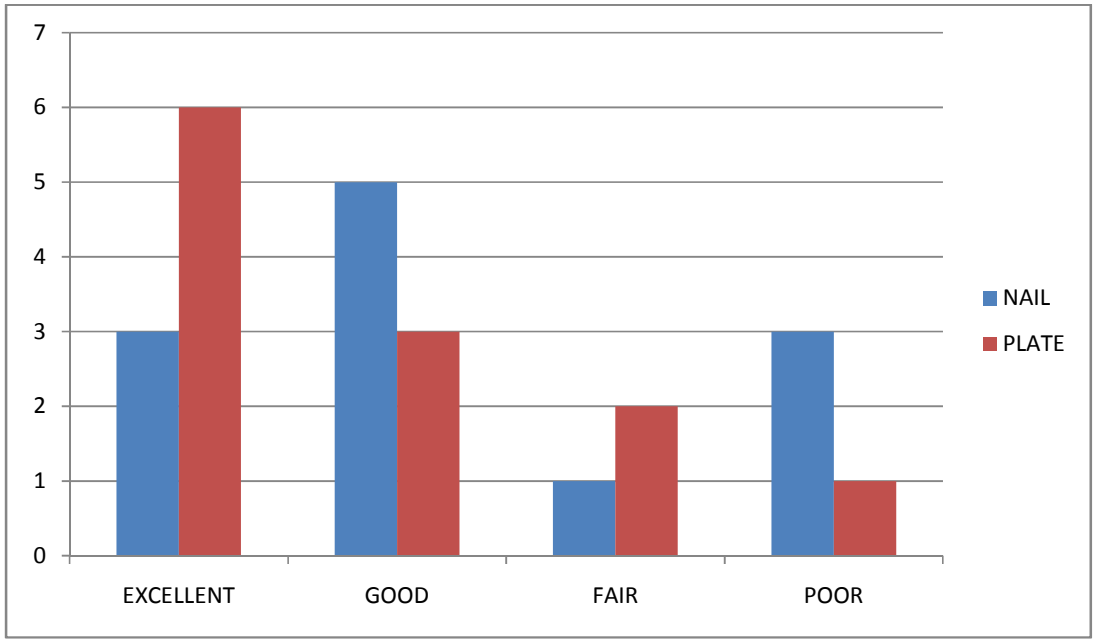
TABLE-8

RATING	ELBOW ROM	SHOULDER ROM	PAIN	DISABILITY
EXCELLENT	EXTENSION 5 FLEXION 130	FULL ROM	NONE	NONE
GOOD	EXTENSION 15 FLEXION 120	<10%LOSS OF TOTAL ROM	OCCASIONAL	MILD
FAIR	EXTENSION 30 FLEXION 110	10% TO 30% LOSS	WITH ACTIVITY	MODERATE
POOR	EXTENSION 40 FLEXION 90	>30% LOSS	VARIABLE	SEVERE

TABLE -9

COMPARISION OF RODRIGUEZ MERCHAN SCORE

RESULTS	NAILING	DCP	TOTAL
EXCELLENT	3	6	9
GOOD	5	3	8
FAIR	1	2	3
POOR	3	1	4
TOTAL	12	12	24



INTERLOCKING NAILING GROUP

SHOULDER ROM

TABLE-10

RATING	PERCENTAGE
EXCELLENT	58.33%(7)
GOOD	25%(3)
FAIR	16.67%(2)
POOR	-

It was found that range of movement of shoulder joint was excellent and good in 83% of cases and it was found to be fair in only 16% of cases

ELBOW ROM

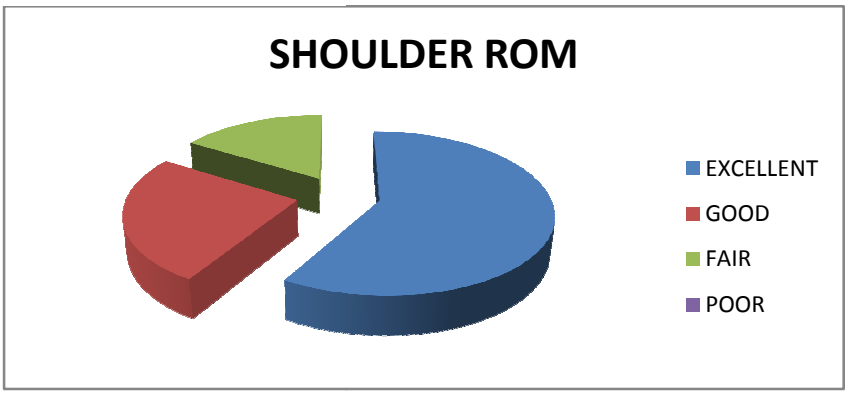
TABLE-11

RATING	PERCENTAGE
EXCELLENT	91.6% (11)
GOOD	8.3% (1)
FAIR	-
POOR	-

The elbow function was found to be excellent in 91% of cases and good recovery was found in 8.3% of cases.

INTERLOCKING NAILING GROUP

SHOULDER ROM



ELBOW ROM

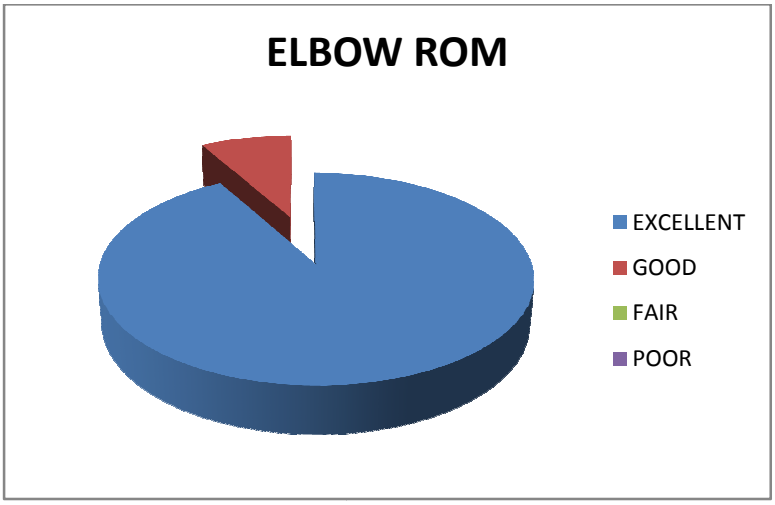


PLATE OSTEOSYNTHESIS GROUP

SHOULDER ROM TABLE-12

RATING	PERCENTAGE
EXCELLENT	75%(9)
GOOD	25%(3)
FAIR	-
POOR	-

It was found that range of movement of shoulder joint was excellent and good in 75% of cases and it was found to be good in only 25% of cases

ELBOW ROM

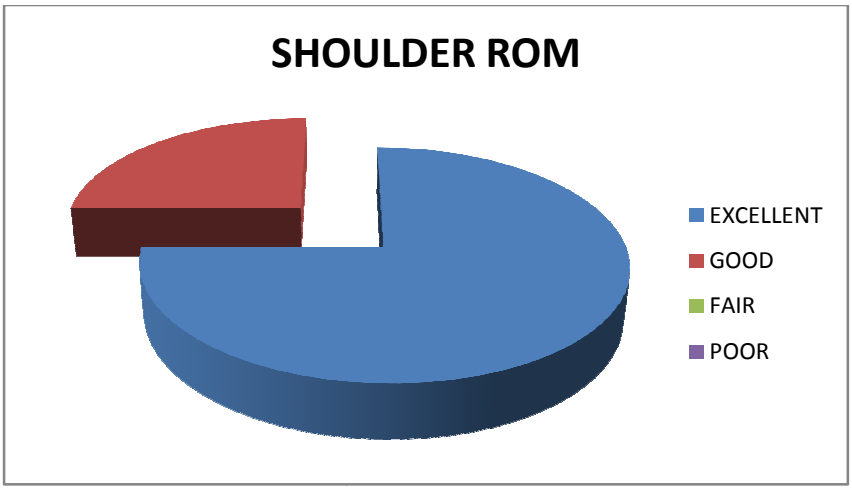
TABLE-13

RATING	PERCENTAGE
EXCELLENT	75% (9)
GOOD	25% (3)
FAIR	-
POOR	-

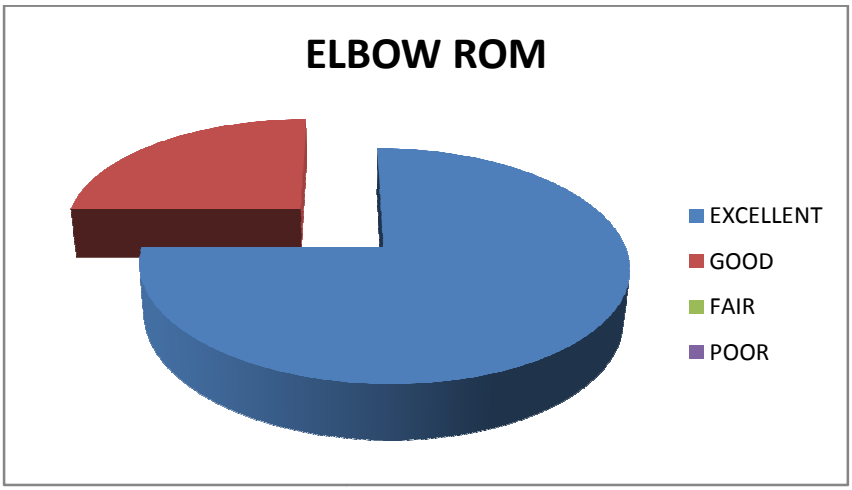
The elbow function was found to be excellent in 75% of cases and good recovery was found in 25% of cases.

PLATE OSTEOSYNTHESIS GROUP

SHOULDER ROM


SHOULDER ROM
EXCELLENT
GOOD
FAIR
POOR

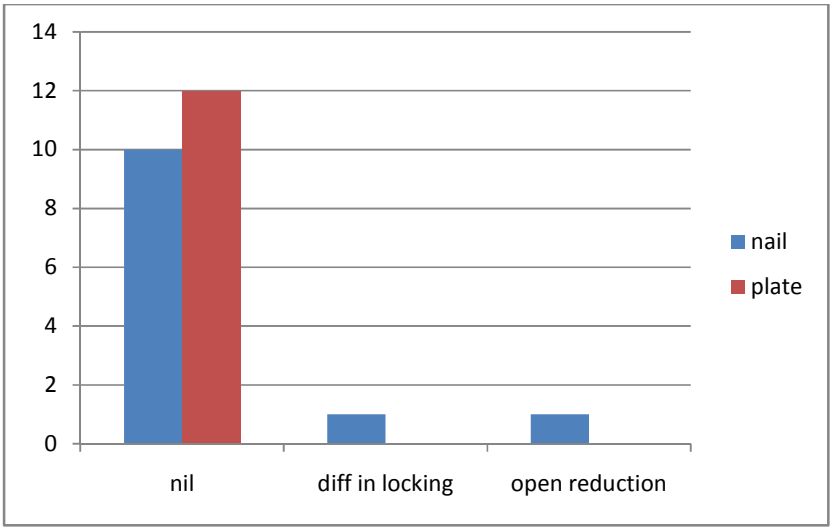
ELBOW ROM


ELBOW ROM
EXCELLENT
GOOD
FAIR
POOR

COMPLICATIONS

Intra-operative complications Table-14

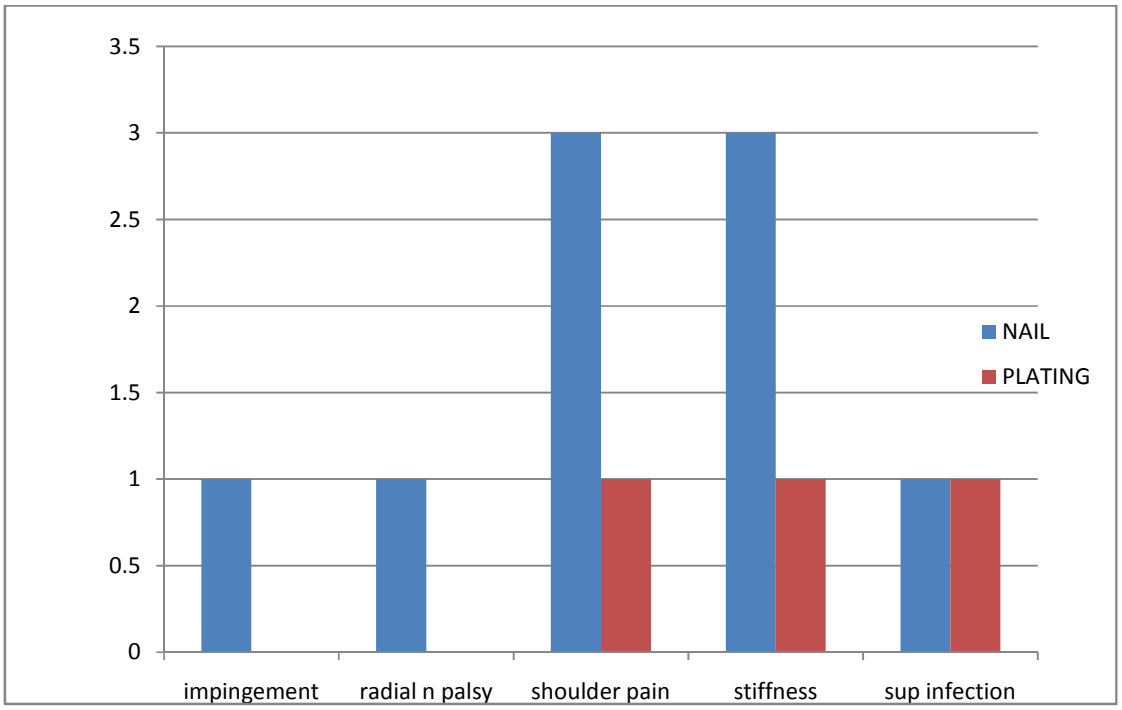
Intraoperative complications	Nail	DCP
#greater tuberosity	0	0
Communition at fracture site	0	-
Open reduction	1	-
Radial nerve palsy	1	0
Problem in locking	1	-
Nil	9	12



POSTOP COMPLICATION

Table-15

POST OP COMPLICATION	Nail	DCP
Impingement	1	-
Non-union	0	0
Post op Radial nerve palsy	1	0
Shoulder pain	3	1
Shoulder stiffness	3	1
Superficial infection	1	1



CASE ILLUSTRATIONS:

INTRAMEDULLARY NAILING

CASE 1`

Name	: PRABHU
Age/sex	:32/Male
Mode of injury	:Road Traffic Accident
Extremity	:Left
Associated injury	:Radial nerve palsy(recovering at time of surgery)
Type of fracture	:C
Time interval between injury and Surgery	:1 week
Nail size	:24X7mm
Reduction	:closed
Post op period	:unevenful
Mobilisation started	:on 3rd post op day
Time of union	:18 weeks
Range of movements	:180^0 shoulder abduction
Complications	:nil(radial nerve recovered fully at 3months)
RODRIGUEZ MERCHAN score	:Excellent

CASE 1

PRE OP

POST OP

6 WEEKS POST OP

3 MONTHS

FUNCTIONAL OUTCOME

6 WEEKS POST OP

3 MONTHS POST OP

CASE 2

Name	:AJITH PRASAD
Age/sex	:32/Male
Mode of injury	:Road traffic accident
Extremity	:Right
Associated injury	:nil
Type of fracture	:A
Time interval between injury and Surgery	:1 week
Nail size	:240X8 mm
Reduction	:closed
Post op period	:unevenful
Mobilisation started	:3rd post op day
Time of union	:18 weeks
Range of movements	:180^0shoulder abduction
Complications	:nil
RODRIGUEZ MERCHAN score	:EXCELLENT

CASE 2

POST OP

3 MONTHS POST OP

CASE 2

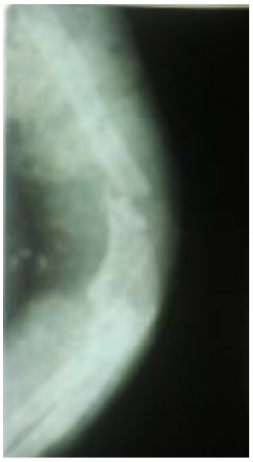
FUNCTIONAL OUTCOME

DYNAMIC COMPRESSION PLATING

CASE 1

Name	:Ragupathy
Age/sex	:23/Male
Mode of injury	:Road Traffic Accident
Extremity	:Left
Associated injury	:Nil
Type of fracture	:A
Time interval between injury and Surgery	:1 week
Plate size	:9 holed Broad Dynamic compression plate
Reduction	:open reduction
Post op period	:unevenful
Mobilisation started	:1 week
Time of union	:18 months
Range of movements	:180^0 shoulder abduction
Complications	:nil
RODRIGUEZ MERCHAN score	:EXCELLENT

PREOP



3 months post op

FUNCTIONAL OUTCOME

CASE 2

Name	:MUNUSAMY
Age/sex	:65/M
Mode of injury	:Road traffic accident
Extremity	:left
Associated injury	:fracture both bones leg left side
Type of fracture	:A
Time interval between injury and Surgery	:3 weeks
Plate size compression plate	:7 holed Broad Dynamic
Reduction	:open reduction
Post op period	:uneventful
Mobilisation started	:1 week post op
Time of union	:22 weeks
Range of movements months	:90^0abduction of shoulder at 3
Complications	:shoulder stiffness
RODRIGUEZ MERCHAN score	:POOR

PRE OP

POST OP

22 WEEKS POST OP

FUNCTIONAL OUTCOME AT 22 WEEKS

DISCUSSION

Intramedullary nailing is considered as gold standard in treatment in fracture of femoral and tibial shaft fractures. But there is no agreement about the ideal treatment for fractures of humeral shaft. This study is to compare the union rate of the fractures and functional outcome between the patients treated with Plate Osteosynthesis and those treated with Interlocking Nailing for fracture shaft of humerus.

In this study, the age group of the patients in both the groups ranges from 20 to 70 years with a mean age of 45 years. Majority of the patients sustained this fracture are males and the mostcommon mode of injury is due to Road Traffic Accident (around 70%) in both groups.

In incidence of non-union after plating has ranged from 2% to 4%. In our study in DCP group the incidence of non-union is 0%. The incidence of nounion in interlocking nail was found to be 0 to 8%. In our study the incidence was found to be of 0%.

This study shows no significant difference between the time of union with an average of 22 weeks in the Interlocking Nailing group and an average of 20 weeks in the Plating group. This is comparable with Ragavendra S et al in their study found no significant difference in bony union between plating group and nailing group in a series of 31 cases. The incidence of radial nerve palsy in humeral shaft fractures was found to be 6 to 15%. In our series the incidence was found to be 12.5% (3cases). All of the 3 cases recovered which was similar to seddonss and pollocks series of 70% and 68%.In the plating group the incidence of post operative radial nerve palsy was found to be 2 to 5%, there was no such cases of radial nerve palsy postoperatively.

The incidence of postoperative radial nerve palsy was found to be 2.6% to 14.3% in the interlocking group in various studies. In our series there was one case post operative radial nerve palsy in nailing group which recovered completely.

There was no problem with infection in our study but one case had superficial infection which subsided with antibiotics.

The rate of intraoperative communition during interlocking nail insertion was found to 7.7% to 10%. In our study there was no intraoperative communition noticed in our study.

In this study shoulder pain occurred in 3 out of 12 patients due toimpingement of nail (25%) .This is comparable to the study by James P.Stannard et al[47] where they showed an occurrence of mild to moderate shoulder pain in about 20% of the patients and also in a study made by Chapman et al[37]there is significant reduction in shoulder movement in the Nailing group. Impairment of shoulder function could due to impingement at the acromian and consequent impairment of abduction. Ante grade nailing is found to violate the rotator cuff. A medial starting point is a avascular area of rotator cuff and it gives entry point for access to medullary canal without compromising the healing of rotator cuff.

CONCLUSION

In our study, there is no significant difference in the period of union of fractures after both the methods .

The chance of infection is more in the Plating group than in patientstreated with closed reduction and Interlocking Nailing patients.

The Restriction of shoulder movements are seen in patients in the Nailing group possible due to Prominent nail tip at the entry site and also due to violation of the Rotator Cuff.

The Advantages of Interlocking Nailing are

1. No need for open reduction of fractures as it is done under C-arm Image Intensifier.
2. Minimal soft tissue dissection.

The Disadvantages are :

1. Inadequate compression at the fracture site.
2. Distraction at the fracture site due to improper nail length
3. Impingement due to protrusion of nail at the site of entry.
4. Exposure to Radiation

The Advantages found in the Plating are

1. Adequate compression at the fracture site.
2. No need for secondary procedure.
3. Less incidence of Non union.

The Disadvantages are

1. Needs more soft tissue Dissection.
2. Careful isolation of Radial nerve has to be done.
3. Chances of infection is more.

The complications were more in our study in the interlocking nail group with most of them pertaining to poor shoulder function with pain. Though both modalities of treatment provide comparable union rates, secondary complications were more in interlocking nailing group. So I conclude that patients can be treated with dynamc compression plating and interlocking nailing for fracture of shaft of humerus. Intramdeullary interlocking nailing is an effective and safe alternative for treatment of diaphyseal fractues of humerus. It is suitable for patients with osteoporosis, polytrauma and in segmental fractures.

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CASE PROFORMA

Name : Case No.:

Age :

Sex :

IP/OP No :

Address :

Occupation :

Final Diagnosis :

D.O.A :

D.O.S :

D.O.D :

MODE OF INJURY

1.Domestic accidents :

2. Road Traffic Accidents :

3.Fall from height :

4.Miscellaneous :

MECHANISM OF TRAUMA

Direct injury

Indirect injury

HISTORY

- History of present injury:
- Duration :
- History of previous injury if any :
- Family history :

GENERAL EXAMINATION :

Pulse :

BP :

SYSTEMIC EXAMINATION :

- CVS :
- RS :
- PA :
- CNS :
- Spine :
- Pelvis :

LOCAL EXAMINATION :

- Site of injury :
- Deformity :
- Wound if any :
- Type of injury :

- neurological complication :
- vascular complication :

INVESTIGATIONS

Blood

Hb% :

Total Count :

Differential Count:

ESR :

X – Ray

ARM Antero – posterior

Lateral view

IMMEDIATE TREATMENT :

U Slab application

OPERATIVE DATA

A.Definitive fixation

- Anaesthesia position
- Entry point
- Implants used
- C-arm position
- Duration of Surgery

- Intra operative complications

POST OPERATIVE DATA :

- Antibiotics/analgesics :
- Date of passive shoulder movement :
- Date of active shoulder movement :
- Date of active elbow movement :
- Date of passive elbow movement :

FOLLOW UP DATA :

- Pain
- Swelling
- Shoulder range of movements
- Elbow movement –range

DURATION OF TREATMENT :6 to 12 weeks

PROCEDURE FOR INTERLOCKING NAILING:

Position of patient : supine

Approach : deltoid – splitting

Entry point :

Methods of fracture reduction : open / closed

Type of nail: stainless steel

Ante grade nail

Details about locking : Proximal and Distal

Size of the nail :

PROCEDURE FOR PLATE OSTEOSYNTHESIS:

Anaesthesia :general / supra-clavicular block

Position of patient : supine / lateral

Approach: anterior / posterior

Types of plates /screws: DCP with 4.5 mm cortical screws

Bone grafting done: yes / no

INTERLOCKING NAILING

SI NO	NAME	AGE	SEX	IP NO	INJURY TYPE	COMPLICATIONS	TIME OF UNION	FUNCTIONAL OUTCOME
1.	ADAM	30	M	7760	closed	--	12 weeks	GOOD
2	PRABHU	32	M	6425	Closed	--	16 weeks	EXCELLENT
3	JAYALAKSHMI	60	F	6132	Closed	Shoulder pain	12 weeks	FAIR
4	ARUMUGAM	55	M	13299	Closed	--	12 weeks	GOOD
5	MUNIRATINAM	32	M	13123	Closed	--	12 weeks	EXCELLENT
6	RAMESH	32	M	21069	Closed	Shoulder pain	18 weeks	FAIR
7	AJITH PRAKASH	30	M	21165	Closed	--	12 weeks	EXCELLENT
8	DEVARAJ	22	M	29858	Closed	Shoulder pain,radial nerve palsy	28 weeks	FAIR
9	LAKSHMI AMMAL	70	F	29898	Closed	--	12 weeks	EXCELLENT
10	VIVEK	25	M	33187	Closed	--	12 weeks	EXCELLENT
11	FATIMA	21	F	35203	Closed	--	12 weeks	EXCELLENT
12	LAKSHMI	60	F	33190	Closed	Shoulder impingement	16 weeks	GOOD

INTERLOCKING NAILING

SI NO	NAME	AGE	SEX	IP NO	MODE OF INJURY	INJURY TYPE	FRACTURE TYPE	ASSOCIATED INJURIES	REDUCTION	BONE GRAFTING	Nail size
1.	ADAM	30	M	7760	FALL	Closed	--	Fracture of both bones forearm	GOOD	No	7X240 mm
2	PRABHU	32	M	6425	FALL	Closed	--	Radial nerve palsy	EXCELLENT	no	7X240 mm
3	JAYALAKSHMI	60	F	6132	FALL	Closed	Shoulder impingement	--	FAIR	No	7X240mm
4	ARUMUGAM	55	M	13299	FALL	Open	--	--	GOOD	No	6X240 mm
5	MUNIRATINAM	32	M	13123	RTA	Closed	--	--	EXCELLENT	No	7X240 mm
6	RAMESH	32	M	21069	RTA	Closed	Shoulder impingement	--	FAIR	No	7X240 mm
7	AJITH PRAKASH	30	M	21165	RTA	Closed	--	--	EXCELLENT	No	7X240 mm
8	DEVARAJ	22	M	29858	RTA	Closed	Shoulder impingement,radial nerve palsy	--	FAIR	No	7X240 mm
9	LAKSHMI AMMAL	70	F	29898	FALL	Closed	--	--	EXCELLENT	No	6X220
10	VIVEK	25	M	33187	RTA	Closed	--	--	EXCELLENT	No	7X240 mm
11	FATIMA	21	F	35203	RTA	Closed	--	Pneumothorax and rib fractures	EXCELLENT	No	6X240mm
12	LAKSHMI	60	F	33190	FALL	Closed	Shoulder impingement	---	GOOD	No	7X240 mm

DYNAMIC COMPRESSION PLATING GROUP

SI NO	Name	Age	Sex	AO type	Mode of injury	IP NO.	Side	Associated injuries	Time interval between injury and surgery	Bone grafting	Plate size
1	Munusamy	65	M	A	RTA	9158	LEFT	BB LEG, CLAVICLE	14 DAYS	-	7 holed BROAD DCP
2	Ragupathy	23	M	A	RTA	10548	LEFT	--	7 DAY	-	7 holed BROAD DCP
3	Paramasivan	65	M	A	FALL	32408	RIGHT	--	12 DAYS	-	9 holed BROAD DCP
4	Kumar	29	M	B	RTA	12725	RIGHT	--	9 DAYS	-	9 holed BROAD DCP
5	Dhilip	55	M	A	RTA	14927	RIGHT	--	21 DAYS	-	8 holed BROAD DCP
6	Kuppu	58	F	A	FALL	18631	RIGHT	--	9 DAYS	-	8 holed BROAD DCP
7	Satheesh	20	M	B	RTA	18575	RIGHT	--	7 DAYS	-	7 holed BROAD DCP
8	Arjunan	27	M	A	RTA	32734	LEFT	--	14 DAYS	-	9 holed BROAD DCP
9	Sundaram	52	M	A	FALL	53678	LEFT	--	9 DAYS	-	7 holed BROAD DCP
10	Annamalai	46	M	A	FALL	00831	RIGHT	--	9 DAYS	-	8 holed BROAD DCP
11	Hepsiba	49	F	B	RTA	16271	LEFT	--	14 DAYS	-	7 holed BROAD DCP
12	Suresh kumar	44	M	A	RTA	31430	LEFT	--	12 DAYS	-	7 holed BROAD DCP

DYNAMIC COMPRESSION PLATING GROUP

SI NO	Name	Age	Sex	IP NO.	COMPLICATIONS	TIME OF UNION	FUNCTIONAL OUTCOME
1	Munusamy	65	M	9158	Shoulder stiffness	24 WEEKS	GOOD
2	Ragupathy	23	M	10548		16 WEEKS	EXCELLENT
3	Paramasivan	65	M	32408		24 WEEKS	GOOD
4	Kumar	29	M	12725		16 WEEKS	EXCELLENT
5	Dhilip	55	M	14927		18 WEEKS	EXCELLENT
6	Kuppu	58	F	*18631*		20 WEEKS	GOOD
7	Satheesh	20	M	18575		16 WEEKS	EXCELLENT
8	Arjunan	27	M	32734	SUPERFICIAL INFECTION	18 WEEKS	EXCELLENT
9	Sundaram	52	M	53678		16 WEEKS	EXCELLENT
10	Annamalai	46	M	00831		18 WEEKS	EXCELLENT
11	Hepsiba	49	F	16271		16 WEEKS	EXCELLENT
12	Suresh kumar	44	M	31430		16 WEEKS	EXCELLENT

INSTITUTIONAL ETHICAL COMMITTEE, STANLEY MEDICAL COLLEGE, CHENNAI-1

Title of the Work : A PROSPECTIVE COMPARITIVE STUDY OF FUNCTIONAL OUTCOME IN PATIENTS TREATED WITH INTERLOCKING NAILING AND DYNAMIC COMPRESSION PLATING FOR FRACTURE SHAFT OF HUMERUS IN ADULTS

Principal Investigator : Dr.P. VINODH RAJKUMAR

Designation : PG in M.S.(Ortho)

Department : Department of Orthopaedics
Government Stanley Medical College,
Chennai-10

The request for an approval from the Institutional Ethical Committee (IEC) was considered on the IEC meeting held on 07.02.2013 at the Council Hall, Stanley Medical College, Chennai-1 at 2PM

The members of the Committee, the secretary and the Chairman are pleased to approve the proposed work mentioned above, submitted by the principal investigator.

The Principal investigator and their team are directed to adhere to the guidelines given below:

1. You should inform the IEC in case of changes in study procedure, site investigator investigation or guide or any other changes.
2. You should not deviate from the area of the work for which you applied for ethical clearance.
3. You should inform the IEC immediately, in case of any adverse events or serious adverse reaction.
4. You should abide to the rules and regulation of the institution(s).
5. You should complete the work within the specified period and if any extension of time is required, you should apply for permission again and do the work.
6. You should submit the summary of the work to the ethical committee on completion of the work.

19/12/13

MEMBER SECRETARY,
IEC, SMC, CHENNAI